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PLAVANIYE VO L'DAKH
(Sailing in Ice).

SAILING IN ICE

M. K. Petrov

Publishing House
MARINE TRANSPORTATION

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In this book all the problems connected with the organization and execution of the sailing of the ships in a variety of ice conditions, are being discussed. The data bearing on the ice cover, the ships sailing in ice, their preparations and work in the ice are given with a view in mind to block, avoid and illuminate the injuries caused to ships by ice.

This book is written for the pilots and other persons of the navigating crew as well as for the employees of the navigation companies and ports participating in the organization of the ice sailing.

The publisher will be obliged to the reader for expressing their opinion on the book, mailing it to: Moscow, Center, Khrustal'nyy per. 1/3, Room 84.

Editor: A. P. Bochek

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INTRODUCTION

The water masses of three oceans - the Arctic, Pacific and Atlantic Oceans - are washing the coasts of the Soviet Union. The length of the coastal line of the USSR is in excess of 50,000 kilometers. The largest rivers in the world drain into the basins of these oceans, and their general length is over 400,000 kilometers. In the Soviet Union there are tens of thousands of lakes, and by the power of the network of its lakes the USSR occupies the first place on the globe.

The maritime and river lanes and the majority of the lake lines in our Fatherland unite and cross each other also with the chief waters of the world ocean. Thousands of ships navigate on these routes, shipping millions of tons of freight and millions of passengers.

All the seas of the Soviet Union, with the exception of the southern part of the Black Sea and a part of the Barents Sea, are covered in the winter season with ice. In some places, for instance in the Sea of Japan and the Bay of Finland, the ice immobilizes the seas of the Soviet Union, chiefly near the shores, for periods of two to four months. On the seas of the Arctic Ocean the ice cover stays up to ten months a year.

Also the rivers and lakes of the Soviet Union are covered in winter with ice for a lengthy period of time.

Periodically such years come to pass when the strength and length of the ice cover staying on even in the southern seas is considerably above the period of the usual average year. Thus, in 1900 - 1901 the Bay of Krasnovodsk in the Caspian Sea, which has never been covered with ice, had been immobilized. The vessels that were frozen-in in the ice were quite helpless since there were no icebreakers in this area. Communication of the ships with the ports was kept up with a great risk and considerable difficulties.

In 1929 and 1947 the central and southwestern parts of the Baltic Sea have frozen in, being covered with a heavy ice cover, even though it almost never happened before. Together with the

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sea also its bays, gulfs, canals and straits were frozen in. The independent movements of the ships were stopped in these areas since they were not adjusted to sailing in ice. Their passage was made possible only by powerful icebreakers.

In the winter of 1953/54 the Azov Sea, White Sea, Bay of Finland and Riga Bay were covered up with heavy ice much ahead in the season than it happened in many years. The approaches to the port of Odessa at a distance of 60 - 70 miles have been covered up with heavy ice, blocking the navigation. The port of Makhachkala in the Caspian Sea was also blocked with ice.

From year to year there is an increasing demand for the sea shipping. Therefore it is necessary to fully utilize the navigational season to transport more freight for the national economy, to secure uninterrupted delivery in the agricultural areas of the goods, machinery and equipment, while the produce of agriculture has to be shipped to the industrial centers.

Quite frequently the periods for preparation of the produce of the crop for loading on board the ships, coincide with the date of ice formation, and the ships have to work in the ice-infested conditions. In some cases the interests of the National Economy require the year-around navigation in various sectors of the sea.

In all the conditions the task of the workers of the maritime shipping, is to prolong, as far as possible, the navigational season in the fall and to start the navigation as early as possible in the spring. This task is being successfully solved in our country with the use of a variety of measures, in each separate sea, depending upon the hydrometeorological and other local conditions. In some cases, especially in the river navigation lanes with heavy hydrotechnical equipment, in the headwaters of the rivers as well as in deep lakes, the change of the temperature in various sectors is made on the basis of utilizing the thermic advantages of the large water masses (for instance on the Dneprov and Shcherbakov Electrical Power Stations). On the seas the sailing period is being prolonged by resort to icebreakers, which guide the ships especially fitted for navigation in the ice-bound waters.

Our country is the Fatherland of the icebreaker. The

Russian scholars have laid the foundation of the since of the ice. To the number of the Russian navigators and scholars engaged in the field of study of the problems of ice formation and the organization of the practice of the navigation in ice, belong M. V. Lomonosov, D. I. Mendeleev, S. O. Makarov, I. and P. Kazantsev, KH. Runeberg, V. I. Afanasyev, V. A. Rusanov, G. YA. Sedov, A. I. Vil'kitskiy, G. A. Ushakov, S. Dezhnev, F. P. Litke, N. Shalaurov, YA. and M. Sannikovy, F. P. Vrangel, M. and V. Pronchishchevy, V. Bering, M. N. Vasil'ev, O. E. Kotsebu, P. K. Pakhtusov, F. Minin, A. I. Chirikov and many others.

Especially great progress has been achieved in the field of investigation of the ice phenomena of the sea, of devising of a technique for combatting the ice, for preparation and education of the professionals in arctic sailing, have been achieved throughout the period of the Soviet Government.

The Soviet scholars and sailors M. Karpinski, YU. M. Shokal'ski, N. M. Knipovich, V. A. and S. V. Obruchevy, A. N. Krylov, V. L. Pozdyunin, V. YU. Vize, M. P. Belousov, A. K. Burke, G. E. Ratmanov, N. I. Khromtsov, V. I. Voronin, M. YA. Sorokin, M. I. Markov and many others have made a great contribution to the task of construction and operation of the ships for sailing in ice.

Guarantee of the successful execution of the tasks, set up by the Party and the Government for the Soviet sailors, is the self-denying and sacrificial work of our captains of the ice-sailing P. A. Ponomarev, K. K. Byzov, A. A. Kacharov, of the fliers, B. G. Chukhnovski, M. S. Babushkin, I. I. Cherevichin, I. S. Katov, I. P. Mazuruk, M. I. Vodop'yanov and many Soviet specialists.

In the present book we submit a brief presentation of the experience of the work of the Soviet sailors in ice navigation.

One must take into consideration that in each basin the freezing and the breaking up of the ice has its own characteristics. The presence of ebb and tide or local currents, the direction and force of the basic winds, the temperature conditions, the thickness and solidity of the ice, as well as other conditions may considerably change the ice situation. Therefore a new set of general prescriptions, which will apply

with equal success to all the cases of navigation in the ice, is quite impossible. Therefore we present here only the basic recommendations for the most typical conditions of navigation in ice.

The above author acknowledges the kind cooperation of the long-distance navigation captains A. P. Bochek, A. I. Dedyurin and especially to the senior captain of the icebreaker fleet M. YA. Sorokin, who, with their valuable advice, assisted in supplementing and improving the present publication.

Author.

CHAPTER I

CONCEPT OF THE ICE COVER

Section 1. Ice Formation

The study of the various varieties of ice, of the conditions of navigation in same, and construction of special ships of the ice-sailing class in our country, was made long ago a matter of close attention.

The first to explain the causes of formation of the sea and to classify them was M. V. Lomonosov in his work "A Brief Description of Various Trips Along the Sea Lanes to Siberia" (St. Petersburg, 1847). This work has been fundamental in the further studies of properties and peculiar characteristics of the ice.

It has been ascertained by the Russian scholars that the condition of the water from its liquid condition into its solid state at certain temperatures and pressures is attended by the formation of the ice crystals, which in their further development grow together into the solid crystal mass of varying density - the ice. The cores of crystallization are formed in the finest suspended particles of the organic and inorganic

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origin, which are always present in the water. For the original formation of the cores of crystallization in the ice there is need for super-cooling of the water, in which case the clearer and the calmer is the condition of the water, its temperature must be so much lower.

If the water has been considerably cooled and in this process also ism mixed, up to its ice formation its temperature may go down to as low as $- 0.2^{\circ}$ C. After this with the increase of the ice the temperature of the water is rising up to 0° C.

The volume of the water at freezing is increased by 9%. The ice achieves its maximum volume at the temperature of -4.4° F; below this temperature it gets compressed.

A great deal of work in studies of the properties, specific disposition, thermic and dynamic conditions of the formation and break-up of the ice has been achieved in the period subsequent to the October Revolution. We have established all the conditions for a wide and systematic study of huge freezing water masses. At the disposition of the Soviet scholars the most perfected technical means have been placed, such as: ships, airplanes, laboratories, institutes.

The Soviet scholars V. YA. Al'tberg, V. I. Arnol'd-Alyab'ev, M. P. Golovkov, S. M. Goryaenko, G. F. Mirchnik, A. B. Dobrovol'skiy, A. F. Kazanskiy, A. A. Shepelevskiy, N. N. Zubov, M. I. Sumgin, E. I. Tikhomirov and many others have built up the science of ice and finally have discredited the generally adopted opinion that the ice cover represents a tempestuous force of the nature, not subject to the will-power of man.

At the present time in our country we have thoroughly studied the ice conditions of our internal seas freezing up in winter, methods of combating ice have been analyzed, the area of the Soviet Arctic Ocean has been conquered, and the northern sea lane has been turned into the normally functioning sea-route.

The most favorable conditions for the start of ice formations appear when the surface of the sea is calm, while the surface strata of the water are freshened up with river waters, and by a considerable release of the heat in the atmosphere when the temperature of the air is below the freezing point. The more favorable are the conditions for ice formation, that much

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finer are the crystals and thereby the more homogeneous and resisting the ice issuing from them.

As the ice starts forming convective currents arise in the surface strata of the sea, the intensity of which depends upon the degree of cooling. Until the moment the surface of the sea is covered with ice, the crystallization cores and the new ice formations appear throughout the entire stratum of water, being mixed up by the process of convection. In addition to convective mixing, there is also mixing of the top layers of water under the effect of currents and waving. As a result of this the depth ice is formed in the sea, while in shallow waters the bottom ice is formed.

As a rule the ice formation in the sea usually starts at the negative temperature of the air and the dropping of the temperature in the surface layer of the water to the freezing point. However in some cases the formation of the ice in the sea begins also at the positive temperature of the air. This occurs when the surface layer of the sea water is very thin and is sharply distinguished by its density from the layers disposed beneath, and also when the atmosphere is quite dry and transparent (in case of a powerful radiation). The temperature of the freezing of the sea water depends considerably upon its salinity. The greater the salinity of the water the lower is its freezing temperature. In Table I we see the inter-dependence between the temperature of freezing and the salinity of the sea water.

In the rivers the cores of crystalization develop before all in a horizontal direction, and therefore prism-shaped crystals are formed, following which, in cells between the cores, plate-like crystals develop.

After union of the cores in a horizontal plane the crystals continue to grow in a vertical plane. As a result ice is formed in the shape of suture of truncated hexagonal pyramids and prisms disposed by their foundation upward.

TABLE I

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Condition of water	Salinity of water in $^{o}/_{oo}$								
	0	5	10	15	20	24.695	25	35	40
Freezing of sea water	0	-0.3	-0.6	-0.8	-1.1	-1.33	-1.35	-1.9	-2.2
The maximum density of water.	3.98	2.9	1.9	0.8	-0.3	-1.33	-1.4	-3.5	-4.5

If in the process of ice formation the water is intensively mixed, the formation of the ice starts at a certain depth and even on the bottom. The ice particles formed below the surface of the water freeze as they contact each other following which, as they increase in size, finally emerge to the surface.

The crystallization cores formed at the objects located on the bottom of the river, forms in their process of development, the bottom or depth ice. From time to time the slabs of the bottom ice, by the measure of their growth, break loose and rise to the surface. When the surface of the water is covered with ice, the depth ice no longer forms since the cooling of the water is discontinued. In swift stream rivers with the rapids, the mass of the bottom ice may exceed, four to five times, the quantity of the surface ice. For instance in the Angara River, almost exclusively the bottom ice is formed. In the rivers with small current speed the ice crystals are formed on the surface of the water. These crystals freeze in and "slush ice" forms. At the low temperature the "sludge" ice appears. Quite frequently the sludge ice increases its mass with such a heavy layer that it reaches down to the bottom itself.

The snow falling on the surface of the river, cools considerably the water and expedites the process of ice formation. The separate small ice floe is frozen into more massive slabs. In narrow places or at sharp turns of rivers the ice wedges in and is stopped forming disorganized accumulations of ice. Then, by its jamming it contributes to quickening of the

solid freeze-in process, which spreads rapidly along the entire river.

Section 2. Varieties of Ice.

As we said before, with the dropping of the temperature of the air and cooling of the water masses, both on the surface of the water and also below the surface the so-called "ice needles" are formed - fine, elongated crystals, which are the original form of the ice. As they freeze in, the ice needles form on the surface of the sea the "ice slush", that is, an accumulation of the floating brilliant spots of the grayish or gray -lead color. With further dropping of temperature and while the surface of the water is at standstill, the slush passes into its following stage: - "the ice bark" or "the glass ice", - a thin, transparent resplendent ice bark. At the slightest stirring of the water surface this "bark" breaks up into glass-shaped pieces.

The snow falling on the cooled water, forms "the snow ice", that is, a viscous grit-shaped mass. From the slush and snow-ice "the sludge ice" is formed, - porous white pieces of ice up to 5 cm thick. On the free surface of the water "the pancake-shaped ice" is formed - that is, the pieces of ice from 30 cm to 2 m in diameter and not over 5 cm thick.

The following stage in ice formation is - "ice rind", that is, a young ice of dark-gray color from 2 to 8 cm thick with a rugged damp surface. As the ice rind increases in size, it takes on a light gray color. From the ice rind and sludge ice the first stage of solid young ice - "Molodik" (young ice) is formed up to 20 cm thick.

A few dozen meters from the shore, the "ice shore area" is formed, that is, tracts of thin ice consisting of the frozen-in snow ice, slush, sludge and rind.

By its structure the young ice may assume the form of needles, sponge or seed. The needle-shaped ice consists of the ice crystals in the form of regular hexahedral pyramids with axis perpendicular to the surface of the sea. Such ice by its

appearance recalls glass. The spongy ice consists of the ice needles, plates and seeds disposed in different directions. The seed-shaped ice consists of round ice grains and separate ice crystals of round shape with irregular axes. The granular ice is formed by accumulation upon each other of the snow and ice.

By the spot of its formation the ice breaks into the surface, depth and bottom ice clasp. The surface ice as the name itself discloses, is formed at the surface of the sea. When the sea is calm its structure comes close to that of the needle ice, and when the sea surface is in motion, then it resembles more the sponge-like formation. The depth ice is formed in the mass of the water between the surface of the sea and its floor. The bottom ice is formed directly on the floor of the sea or around the objects located on the bottom, for the most part near the shore. The depth and bottom ice have a spongy structure. As the bottom ice develops in size, it quite frequently emerges to the surface, picking along the particles of the ground.

As the temperature of both air and water drops, and also in the absence of waving, a considerable part of the water surface is covered with the primary formations of the ice, after which its further growth is directed downward. The speed in the ice growth depends upon the depth of the sea, temperature and salinity of the water, of the currents and other local conditions. Quite frequently the growth of the ice is over 10 cm per 24-hour day. The solidity of the ice depends upon the temperature of the air and water. The lower their temperature, that more solid is the ice.

The ice cover, especially at sea, is continuously subjected to changes. By the wind and currents the ice is in part rarified, and in part forms channels, ice puddles, tidal leads and shore leads, and is compressed, solidly frozen in, thus forming the heavy homogeneous solid ice.

By their origin the ice classes are subdivided into the sea, river ice and glaciers. The sea ice is more elastic than the fresh-water ice, and therefore it is more difficult to break it into fragments. The river ice is carried into the sea from the rivers in the spring-tide movement. In the ice regimen

of the polar seas the part played by the river ice is not significant, since there it is confronted in considerable quantities at the estuaries of the rivers at the beginning of the spring, with regular ice of the sea, and later it melts and only to a small degree it combines with the sea ice groups. We shall come across the most frequently the so-called bay ice, which forms near the coast from freshened water and resembles to a high degree the river ice.

The glacier ice (Figure 1) is met with in the polar seas in the form of ice mountains - icebergs or ice bolders, which chip off their original locations and descend to the sea in the form of glaciers. The Soviet scholars, G. A. Ushakov, P. A. Gordienko and others, and also the polar fliers, I. I. Cherevichny, I. P. Mazuruk, the pilot V. I. Akkuratov and others, have discovered the presence in the polar ~~Act~~ Arctic Sea of large ice islands stretching in length up to 35 kilometers and reaching the width of 20 kilometers.

Figure 1. Iceberg drifting in the northern Atlantic.

The icebreaker MIKOYAN investigated in August 1947 an island of this kind, which was drifting in the central part of the East Siberian Sea. The surface of the ice island was rugged and rolling, with the height of slanting hills up to 5 - 6 kilometers, with gulches and valleys, and frozen-in creeks.

Distinction is made between the drifting and immobilized sea ice. Drifting, or floating, is the ice of a variety of sizes and forms (beginning from small slabs and coming up to huge fields and icebergs, which move freely under the effect of winds and currents (Figure 2). The drifting ice is the most dangerous for the ships. It can be brought out with the ice to the banks, shoals, underwater reefs and smashed-up by the floating ice fields. Besides this, when sailing in the drifting ice in the absence of the shore landmarks, and while being unable to determine the location of the ship by astronomical means, one has to sum up accurately the trail of the ship.

Figure 2. Drifting ice.

Among the floating ice groups we find:

Ice fields - floating ice groups two to three miles long, which may be smooth or rugged, aged with many years, or one year formations (Figure 3);

Figure 3. Ice fields.

The debris of fields - the floating ice masses from 200 meters to 2 to 3 miles long formed out of destruction of the ice fields (Figure 4);

Figure 4. Debris of the ice fields.

The heavy slab ice - the fragments of the floating ice from 20 to 200 meters long (Figure 5);

Figure 5. Ice broken up into massive slabs.

The crushed ice - with pieces up to 20 meters long (Figure 6);

Figure 6. Ice broken up into small slabs.

The ice grits - the ground ice, mixed occasionally with the sludge and snow ice, but most frequently met with between the ice fields and the coastal areas (Figure 7);

Figure 7. Ice grits.

At the edge of the ice fields the ice grits are formed

under the effect of the winds, washed off by the action of the waves when the wind is blowing from the open sea;

Floebergs - are deep-seated hummock-shaped ice formations, with a relatively short horizontal stretches (Figure 8);

Figure 8. Floebergs.

The pack ice - is an ice mass of many years formation in the form of fields or split-off fragments of great thickness and solidity, which are carried out from the central portion of the Arctic basin (Figure 9);

Figure 9. Pack ice.

The immobilized ice or land floe (Figure 10). As a rule the land floe covers bays, inlets, straits and other areas of the sea more or less limited by coastal delineation. However it happens that the land floe may spread out hundreds of kilometers away from the coast (especially to the shoals). In most cases the limits of the land floe is a line 20 of 20-meter depths. This is explained by the fact that the greatest depth of the hummocks reaches down to 20 - 25 meters. When settling on soals near the coast, the hummocks form the immobilized ice - the land floe.

Figure 10. Immobilized ice or the coastal or land floe.

The land floe in its primary stage of formation is called the fast ice (shore lead). This is an immobilized thin layer of the young ice frozen onto the shore, consisting of the ice slush, snow ice, sludge ice, pancake ice, etc. The coast ice may spread to a tract of several dozens of kilometers.

A part of the shore lead, which is connected immediately with the coast and is not subject to fluctuations along with the surface of the sea, is called the sole or the bottom of the ice, or the bay lead. The ice foot is formed as a result of

of gradual freezing. At great rise of the sea surface connected with the force of the wind or tidal waves, the ice frozen to the shore is flooded with water; the water is mixed with snow. Due to this circumstance the ice foot obtained its own particular structure. At a considerable waving of the water level near the shore the ice foot may reach considerable thickness and, as a rule, especially toward the end of the winter, it is covered with a thick layer of snow. Sometimes it rises above the remaining part of the land floe with an elevation, along which a crack passes up to the water.

A powerful land floe of many years, which forms in the bays and inlets of high altitude is known by the name of "sikozak" (an Eskimo word meaning very old ice). Due to accumulation taking place every year and due to the melting of the snow, both the ice and sikozak become stratified.

To ice formations belong the following:

hummocks of pressure ridges - accumulations of the frozen-in ice slabs formed by the compression of the ice; considerable platforms of ice, covered up with the compressure hummocks are called "hummock ice" (Figure 11);

Figure 11. Icebreaker "ERMAK" in hummocks of pressured ridges.

"Ropaks" or small hummocks piled edgewise - are separate ice slabs stuck up sideways, frozen into fields and towering above their surface (Figure 12);

Figure 12. Small hummocks piled up edgewise.

"Podsovy" or blocks of the underwater parts of sea hummocks - are the ice slabs stratified one above the other as the ice groups get compressed and form the underwater part of the hummock.

The ice groups occur in a large variety of shades. The young ice (sea) is usually green in various shades - from the

pale green up to the dark green color. The more salt contents in the ice, together with the air bubbles, the lighter it becomes. If by reducing the contents of the salt and the air bubbles, the ice assumes a bluish shade of color.

The most solid old ice contains a small quantity of salts and air bubbles and thus becomes blue; the least solid ice with a considerable contents of snow and air bubbles, becomes whitish in color, and the weakest thin shore ice, with the exception of the ice crust has the dirty shade.

An ice of many years of duration, which was formed only as a result of freezing, is distinguished by a transparent blue color, and such that has layers, will appear with a greenish or bluish shade, depending upon the thickness of the ice pieces composing it. The ice mass which joins the separate ice slabs with each other is almost white and nottransparent. A yellowish shade of ice points to the presence in the water of alien additions.

The coastal wash and the residue of the plankton lend the ice a dark gray, reddish and even soil - black color. Such an ice is called dirty; it is frequently met with along the lanes of the Arctic sea route.

The ice of the river or coastal origin has a brownish shade, since, as a rule, there are in it admixtures of the clay substances and humic acids.

The glacier ice has a bluish color and as it melts, it gives fresh water, which is even drinkable. In spring at melting on the surface of the ice fresh water - "snow water" - appears, which during the new freeze will be covered with a thin ice - "glaciated snow rind". When sailing in the Arctic or Antarctic waters the sailors usually replenish their supply of fresh water from such snow water pools, or by cutting out slabs of glacier ice, or sludge.

One should note that the above mentioned varieties of ice groups cannot be taken as an exhausting classification. In each sea, basin, river, the ice had its own specific properties, which are described in the corresponding sailing directions.

A systematic classification of ice groups was effected

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by the Soviet scholars only for the Polar Sea.

In 1939 the Publishing Office of the Main Arctic Navigation Sea-route had issued an "Album of the Ice Formations" which represented the first extensive classification of the ice groups of the Polar Seas. Recently a publication has been issued under the title "Classification and Terminology of the Ice Groups Appearing in the Sea" by a committee consisting of representatives of the State Oceanographic Institute, the Arctic Scientific Investigating Institute, of the Main Hydrographic Office, and others. (See attachment No. 1).

Section 3. The Sailing Characteristics of the Ice Varieties.

The general condition of the ice in a certain area of the water space and passability of this ice by the vessels of different classes, that is, the strength of the ice groups, their distribution on the surface of the sea, the nature of separate accumulations, determine the sailing characteristics of the ice.

For determination of the sailing characteristics, besides a certain number of special names, a ten-ball system of thickness of the floating ice has been set up: 1 ball indicates that 10% of the sea surface is covered with ice, 10 balls indicate that the sea is entirely covered with ice. In Table 2 there is a scale of thickness of the floating ice.

Depending upon its ball values, age, solidity, nature of its disposition on the surface of the water, the ice is denoted by a special name:

Stamukha - a large ice bolder in shallow water;

Rarified (rotten) ice - a broken-up floating ice of various descriptions, occupying much less space than the clear water (not in excess of 30%), and spreading

all over the visible surface of the sea, more or less equally; by the ten-ball system such condition is identified by one to three balls;

The rarified (rotten) ice - a variety of formation of broken-up ice covering about 60% of the visible surface of the sea; this type of ice is identified by four to six balls (Figure 13);

Figure 13: Rarified ice.

Condensed ice - a considerable accumulation of the floating ice of various descriptions, occupying not less than 70% of the surface of the sea; such ice is identified by 7 to 9 balls (Figure 14);

Figure 14: Consolidated ice.

Solid packed ice - an ice mass covering with a monolithic mass of a large water space; such an ice is identified by ten balls.

Below we present the terminology that is most widely used in ice navigation.

Heavy ice - powerful, hummock and solid type of ice, which can be negotiated with difficulty even with the most powerful icebreakers. Under the young ice groups we understand formations of different kinds: the ice rind, the young ice, the shore floe, etc. Ice of many years of duration is the ice which did not melt in the course of summer and was frozen at least throughout two winters. The thickness of such ice in even sections is usually over two meters. The ice tracts which sometimes are called the ice belt, consist of a crushed floating ice disposed in clear water with long narrow sectors (Figure 15).

Figure 15: Ice tracts.

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TABLE 2

Ball	Relation of the surface covered with floating ice masses to the surface free from ice.		Characteristics
	Determination in figures.	Description of the nature of the surface.	of the ice
0	0 : 10	The entire water surface is free from ice.	Clear water
1	1 : 9	The area of the ice slabs is 9 times smaller than the surface of clear water.	Very rare ice.
2	2 : 8	The ice area is 4 times smaller than the area of the clear water.	Very rare ice.
3	3 : 7	The ice area is 2 - 2.5 times smaller than the surface of clear water.	Rare ice.
4	4 : 6	The ice area is 1.5 times smaller than the surface of clear water.	Rarified ice.
5	5 : 5	The area of the ice surface equals the area of the clear water.	Ice of medium thickness.
6	6 : 4	The area of the ice cover is 1.5 times larger than the area of the clear water.	Condensed ice.
7	7 : 3	The area of the ice mass is twice to 2.5 times larger than the area of the clear water.	Thick ice.
8	8 : 2	The area of the ice mass is four times larger than that of the clear water.	Very thick ice.

[redacted]

Table 2 contd.

9	9 : 1	The area of the ice cover is nine times greater than the area of the clear water	Almost solid ice.
10	10 : 0	Ice masses cover the water area throughout (without intervals).	Solid ice.

The clear water or, with other words, open water - stands for large areas of water free from ice. The water sky - is the dark reflection on the clouds above a considerable area of open water; the ice-sky - is a characteristic whitish reflection on the clouds above the accumulation of ice grits disposed beyond the limits of visibility.

The ice rim - is the frontier between the clear water and the ice both floating and solid. The tide lead is an area of clear water between the ice masses formed under the effect of the tidal currents or winds. Pool or shore lead is a relatively small area of clear water amid the ice masses both floating and solid (Figure 16). The ppols located at the shore are called shore leads.

Figure 16: Pools of water.

The passability of the ice cover is appraised by the degree of its destruction and its underwater mass. The less the ice is destroyed and the heavier its underwater mass, that much less it is passable for the ships. The hummock character of the ice is determined by the six-ball system (Table 3).

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[redacted]

TABLE 3

Ball	The surface of the ice is covered with hummocks (ice ridges) in percentage	The characteristics of the surface of the ice.
0	0	Smooth ice.
1	up to 10	Even ice with but few ice ridges.
2	about 30	Area covered sparcely with ice ridges.
3	about 50	Ice area with the ridges.
4	about 70	Ice area covered with high and close ice ridges.
5	about 90	The ice hummocks throughout the water space.
6	abuut 100	The same.

When sailing in the open ice groups the vessels are risking to get a hull injury by striking the underwater part of the ice mass, frequently emerging in the form of a battering ram. This is why it is of utmost importance to be able to determine by their appearance the depth of submersion of various types of the ice masses.

The level fields of old ice are submerged in the water within the limits of 5/6 to 6/7 of their thickness; the ice floe is from 4/5 to 5/6 underwater; the ice ridge fields are from 3/4 to 4/5 underwater, the highly ridged fields are from 2/3 to 3/4 underwater and in the stranded hummocks (Stamukhi) - from 1/2 to 2/3 of its thickness.

Depending on their shape the icebergs have the following ratio of their submerged part to the surface part:

Table-shaped icebergs	5 : 1
Round icebergs	4 : 1
Pyramidal icebergs	3 : 1
Column-shaped icebergs	2 : 1
Wing-shaped icebergs	1 : 1

When sailing among the ice groups not only their classification by the ball system is of anysignificance, but also their thickness. The thickness of the ice is usually determined with bare eye. With sufficient expérience the error can be very insignificant. When anchoring and in case it is necessary to determine accurately the thickness of the ice or to determine its increase for a certain period of time, the ice measuring rod is used (Figure 17).

Figure 17: Graduated ice measuring rod with an angle.

In the fall or winter season one must know not only the thickness of the ice which appears at a certain moment in the navigation area, but also the thickness of the ice which may be met with on the trip, and also to what extent, under certain determined conditions, the thickness of the ice can be increased.

The Soviet scholars have worked out computation methods for the increase of the thickness of the ice. Being apprised of the initial thickness of ice in centimeters i_o (Table 5) and the number of degree days of the subzero weather R, one can determine by the Table 4 roughly the thickness of the ice which will be met with on the navigation trip.

The thickness of the ice can be computed approximately also by the daily increment at a certain negative average

temperature of the air and the initial thickness of the ice i_o (Table 5).

In the time preceding the Revolution the navigation in the ice-bound areas was carried on solely on the basis of the experience of the ship captains. At the present time the ice-bound navigation is effected in an organized manner. Special shore stations are making systematic observations on the ice conditions. The data of these observations serve as a foundation for the make-up of the short and long period ice prognostications and special ice charts.

On Figure 18 the conventional markings of the ice sailing charts are displayed. For the analysis of the prognostications of the ice conditions, in addition to the sailing reconnaissance, also the winter prenavigational and the fall postnavigational flight reconnaissance are made. The data on the synoptic set-up (the direction and force of the winds) and temperature regimens will make it possible to conclude to the distribution and strength of the ice masses throughout the impending sailing season.

TABLE 4

Initial thickness of ice i_o cm.	Number of the R[1] zero weather days										
	100	250	500	1000	2000	3000	4000	5000	6000	7000	8000
0	13	26	43	68	104	132	156	177	196	213	229
10	20	32	47	71	106	134	157	178	197	214	230
25	32	42	56	77	111	138	161	181	200	217	233
50	55	62	73	92	122	147	169	189	207	223	239
75	79	85	93	109	136	159	180	199	216	232	247
100	104	108	115	129	154	174	193	211	227	247	257
150	152	156	161	171	191	209	225	241	255	269	283
200	202	204	209	217	233	248	262	279	289	301	313
300	301	303	306	312	323	335	346	357	367	377	387
400	401	401	402	409	418	427	436	455	453	461	469

Footnote: The number of the R zero freezing days is the result of the number of days multiplied by the mean negative temperature of the air.

Table 5

Initial thickness of ice in cm, l_0	Daily average temperature of the air, t^0					
	-5	-10	-15	-20	-25	-30
0	0.8	1.6	2.3	3.0	3.7	4.4
5	0.7	1.3	1.9	2.6	3.2	3.8
10	0.6	1.1	1.7	2.2	2.6	3.4
15	0.5	1.0	1.5	2.0	2.4	2.9
20	0.4	0.9	1.3	1.7	2.2	2.6
30	0.4	0.8	1.1	1.4	1.7	2.1
40	0.3	0.6	0.9	1.2	1.5	1.8
50	0.3	0.5	0.8	1.1	1.3	1.6

The results of the flight reconnaissance are also marked on the chart. On Figure 19 the conventional markings are traced for the ice charts of the winter prenavigational and fall post-navigational flight reconnaissance.

The systematic prognostications, the constant observations of the ice masses, the aviation reconnaissance over the ice-covered areas are of great assistance to the ship captains. In combination with personal experience and expert familiarity with the local conditions, prognostications and reconnaissance of the ice conditions help to better organize ice navigation and to fully take advantage of the favorable conditions as they emerge in certain sectors.

Figure 18

CONVENTIONAL MARKS FOR THE ICE SAILING CHARTS

The shore lead.	Ice containing impurities.	Assumed ice.
Ice ridge, the limit between the ice of various solidity. The same is however merely assumed.	Fields with round shape	Solidity
Clear water.	Packs	Decay
Slush, needles, sludge, snow-ice.	Stranded hummock (Stamukha)	Thickness of ice in cm.
Pancake-shaped ice, ice rind, young ice.	Hummocks	Condition marked by hummocks.
Fine crushed ice.	Layers of hummock.	Drifting of the ship.
The coarse crushed ice.	Icebergs Floebergs	Washout holes.
Angular shaped fields.	Snow fields in the water.	Direction of ice drift.
Frozen-in fields.	Cracks.	Fog.
Broken fields	Tide leads	Direction of airplane flight or course of ship.

On the color charts the conventional markings of the prevailing shapes and forms of the ice masses in the zone of a differentiated solidity, are indicated by several margins with the symbols of solidity.

'- the ice of 9 - 10-ball-solidity is colored with brown color.

'- the ice of 7 - 8-ball solidity is colored with light brown color.

'- the ice of 4 - 6-ball-solidity is colored with a green color.

'- the ice of 1 - 3 balls solidity is colored with a light green color.

'- the clear water is colored with a blue color.

Figure 19

CONVENTIONAL SIGNS FOR ICE CHARTS OF THE WINTER PRE-NAVIGATIONAL AND FALL POST-NAVIGATIONAL AERIAL RECONNAISSANCE

Clear water	Slush, needles, sludge, snow ice.	Pancake-shaped ice, floe, young ice.

YOUNG GRAY ICE (up to 10 cm)

Continuous ice fields (frozen in).	Broken up fields.	Ice floe	Heavy crushed ice.	Fine crushed ice.

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/Figure 19 - Contd./

YOUNG GRAY - WHITE ICE

(thickness from 10 to 30 cm)

Continuous ice fields (frozen in).	Broken up fields.	Ice floe.	Coarse crushed ice.	Fine crushed ice.

YOUNG WHITE ICE (thickness from 30 to 100 cm)

Same.

ICE FORMED IN THE FALL AND OF ONE YEAR OLD

(thickness 100 cm)

Continuous ice fields (frozen in).	Broken up fields.	Ice floe.	Coarse crushed ice.	Fine crushed ice.

TWO OR THREE YEAR-OLD ICE

Same.

PACK ICE

Pack ice.	Ice edge, borderline between the ice groups of varying solidity.	Same only assumed.

THE SHORE LEAD

Year-old autumn shore floe.	Shore lead 2-years of age or formed from a 2-year old or several years old freezing of ice.	Shore lead, fall ice with the inclusion of the old ice.

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/Figure 19 - contd./

HUMMOCK CONDITIONS

Indicator of hummock condition.	Irregular hummock conditions.	Hummock condition in rows.	Berriers of the Hummocks	Floating hummocks.

INDICES OF THE QUANTITY OF THE ICE

Index of solidity	General solidity of the old and young ice.	Decaying.	Thickness of the ice in cm.

VARYING CHARACTERISTICS

Course of the air flight.	Dirt infested ice.	Fog.	Icebergs. Floebergs.	Tide leads.	Direction of the drifting ice.

Cracks in certain directions.	The washed-up holes.	Snow-water pools	Cracks in different directions.

Section 4. Rotting and Break-up of the Ice Masses

With the rise of the temperature of the ice to 0°, it begins to melt and evaporate. The more rugged is the surface of the ice, the more intensively the processes of evaporation and melting take place.

Sooner than anywhere else the ice begins to melt at the shore as a result of the draining of the shore waters in the sea, under the effect of a more active absorption of the heat coming from the radiation of the sun with the aid of the dirty shore ice, and due to its greater crumbling characteristic. The decay, break-up and melting of the ice take place

simultaneously and may continue until its complete destruction.

These processes are subdivided into separate stages.

To the first stage of the weakening of the sea ice is the internal deformation emerging in the ice after its temperature begins to rise. In the spring on the surface of the snow which is spread over the ice cover, a shining silver-like crust is formed, under which the accumulation of the warmth of the sun radiation begins. By the measure that the sun rises above the horizon and as the air temperature increases, the snow becomes solid, the hummocks are pressed down, the abutting parts of the ice cover begin to melt, the thermic cracks appear and increase in size. Following this the snow covering the ice surface melts, and water masses of the snow water begin to appear. When they freeze in again these water bodies are covered with ice, protecting the water from further cooling. Further the holes formed in the snow water melt throughout and through the openings so formed, the water drains under the ice. With this the process of the ice decay is completed. In this manner in the first stage of its decay the ice breaks up into its parts, and begins to float while the number of cracks in same increases.

In the second stage the shore floes turn into the floating ice masses, the broken-up ice groups assume a round shape. The ball force of the ice is reduced, and as the water is stirred up into waves, it begins to wash off. The draft of the ice masses in the water is increased, their dimensions are reduced. When the various fields and ice masses collide, the elevation of ridges takes place. Finally the ice blocks turn into the so-called ice lillies and ice ducks.

The hummock-shaped ice fields turn in calm weather gradually into even fields, their thickness is reduced and they start to resemble the young ice crust masses.

In the third and last stage the stage of decay the ice masses disintegrate into separate ice needles.

The Soviet scholar Somov worked out a five-ball scale

for comparison of the degrees of decay of the sea ice by way of melting in the spring:

1.ball - complete absence of the external signs of decay; the ice breakage is sharp; the surface is white.

2 balls - a small number of snow cracks: the wash is absent; the ice is ground to the extent that formation of the edges of the ice are round, frequently appearing in the form of ice balloons, overhanging the surface of the water; the surface of the ice is mostly white.

3 balls - a large number of snow puddles; occasional holes; the edges of the ice covers are round, frequently appearing as ice balls overhanging the surface of the water; the surface of the ice usually is white.

4 balls - a large number of holes and snow water puddles, connected between themselves with cracks; the surface of the ice frequently reminds of a lace; the ice dams between the holes are still white or dark brown (if a certain quantity of the mineral - organic deposits are present in the ice); in the broken-up ice frequently ice masses are met with, with a mushroom-like shape, with a noticeable protuberances and under-water parts of ice blocks; small-size ice blocks are thoroughly permeated with water and have a gray color.

5 balls - the ice is thoroughly decayed through melting, it sets deeply in the water; above the water only the peak parts of the ice blocks appear, they are thoroughly permeated with water and have a gray color; most frequently the ice is met with in the form of shapeless small debris, the lower and upper surfaces of which cannot be distinguished; characteristic is the presence among the separate ice blocks of a large number of quite small pieces of ice permeated with water, (representing the remains of the disintegrated ice masses). They resemble to a certain extent the ice grits, in some cases the ice preserves the side of the round field covered with a large number of holes, and by their

appearance resembling a lace work (even ice of the spring origin); at slight angles of friction the ice can be hardly distinguished from the clear water. After this the ice unnoticeably vanishes from the surface of the water.

With the onset of the warm weather the melting of ice and snow begins also on the surface of the rivers.

Here too, the melting process runs more intensely around the ice edges. Due to draining of the thawed water the level of the river rises, the ice is broken off from the banks and tracts of clear water form in the river. In possession of a dark surface, the water absorbs more sun energy, its temperature rises and the ice begins to melt not only from the top, but also from the bottom.

As the water level rises, the ice breaks up into ice slabs, which are further crushed, and float down the river. The higher is the rise of the level, the more intensive is the ice flow.

On the rivers which run from north to south, the melting of the ice and the ice drift is less intensive. On the rivers running from south to north, the melting and decay of the ice begin from the upper reaches of the river while the lower course is still locked with solid ice cover. As a result of this a large rise of the river water level takes place, attended by a stormy drifting of the ice. In order to prevent extensive floods, the ice in the lower courses of the rivers is broken up artificially (with icebreakers, blasts, bombs thrown from airplanes, etc.).

Section 5. Visible Signs Indicating the Approach of the Vessel to the Ice Masses at Sea.

While sailing in the clear water, - as we approach the icy region, - it is very important to determine the disposition of the ice masses in due time.

The approach of the vessel to the ice edge can be determined by a whole series of signs and, in particular, by the ice sky, that is, by the reflection of the ice on low hanging clouds, which can be seen both at night and in daytime. The ice sky appears at first in the shape of a narrow tract or spot on the horizon and as the ship comes nearer the ice edge, it continuously grows both on the horizon as in the altitude. Especially sharp is this phenomenon when observed at the time of cloudy weather and low hanging clouds. The reflections of the ice are visible above the horizon at a considerably greater distance than the ice itself. These reflections have a yellow - white color as their characteristic.

On a relatively short distance from the edge of the ice one can spot at the horizon the delineation of the ice raised up by the phenomenon of refraction in the form of a brilliant light tract.

In the case of a strong wind the sign of the ship's approach to the ice, while sailing windward, is the gradual reduction of the altitude of the wave. The proximity of the ice is disclosed sometimes by the appearance of seals or bird flocks at a great distance from the dry land or islands.

At the same time the lowering of the temperature of the air and water may also serve as a sign that the ship is coming closer to the ice masses, however, this sign is not reliable in all cases. The temperature of the air frequently drops only when considerable masses of ice are disposed at a short distance from the ship windward.

Expecting to meet the ice, it is necessary not only to carefully observe the horizon, but also to listen to the sounds. When the ice is compressed, and also under the effect of waving, wind and currents during the destruction of icebergs, a characteristic noise spreads, which frequently can be heard at a long distance and warns the ship's captain

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of his coming close to the ice area.

If the edge of the ice is disposed windward in relation to the approaching vessel, the sign of approach to the ice may be also small chip-offs of ice. As the ship comes closer to the edge of the ice area these pieces become quite sizable.

CHAPTER II

VESSELS FOR ICE NAVIGATION

Section 6. Development of the Ice-breaking Fleet.

In the XVI - XVII centuries the "icebreaker" in Russia was called "a man equipped with the ice chisel, with which he had been breaking the ice in order to rescue the ships stuck in it and to lead them to a safe anchorage. Of course, one could not even dream to navigate in such manner to considerable distances, however, a noticeable success in the towing of vessels on rivers was achieved with difficult and lengthy work only when the thickness of the ice was not over 15 cm. Then they began to break up ice with blasts, in which case at first they used gunpowder and then dynamite.

On northern Russian rivers in the XVII Century the so-called "icebreaking canoes" were used (Figure 20). These were heavy wooden waterproof canoes about 22 meters long and about 2.5 meters wide, with a bottom draft of about 1.5 meters. "The icebreakers" had at first cut out by manual labor a furrow in the ice about one-half meter wide, and thereafter towed the icebreaking canoe on both sides of the furrow by four ropes. In such a channel broken through by the canoe, the actual ships were towed. This method could have been used at towing of the ships when the ice cover was not very thick and even then to small distances. Later on they began to use the "icebreaking sleighs" or barges with a

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raised stern loaded with rocks or iron (Figure 21). To such barges they harnessed 20 horses, or more. The icebreaking barges were more efficient than the icebreaking canoes and were capable of breaking through the ice up to 30 cm thick.

Figure 20. Icebreaking canoes.

Figure 21. Icebreaking sleighs.

Much attention to the problems of work-out of a technique for the struggle with the ice conditions was devoted by M. V. Lomonosov in his work "Preparation to Sailing Trips by Way of the Siberian Ocean". He required from the vessels of ice navigation the maximum of maneuverability. Lomonosov wrote that "- the vessels should be plated with planks against the ice", that is, he proposed to introduce in the construction of the iceabreakers an ice belt, which up to these days is used, in one form or another on vessels navigating in ice. Besides this Lomonosov proposed to build ships with more even hull sides, with curved formations of the bow and the hull side. Such vessels could more effectively navigate in dense sludge, in floating ice, resist the compression by the ice masses.

Much has been done during the reign of Peter the First in order to adjust the ships to the conditions of ice navigation. Peter the First built the Navy, which had been considered as one of the most powerful in Europe. Many new and original features had been introduced by the Russian "ship carpenters" in the construction of the vessels for sailing in the ice conditions. Besides, this circumstance made it possible for Peter the First to carry out in 1710 for the first time in history one of the largest military operations in ice, in which up to 270 large and small wooden ships participated.

This operation had been undertaken for the capture of Vyborg and provisionment of the Russian troops besieging the fortification, artillery, ammunition and provisions. The

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Russian transportation fleet could, under the protection of the sailing and galley fleet, break through the ice 30 - 35 cm thick, while the fleet of the Swedes, sailing to render assistance to the besieged fort, was contained by the ice in the central part of the Bay of Finland. The role of the ice-breakers at the leading of the freight-carrying ships in this operation had been carried out by the frigates "DUMKHAT", "OLIFANT" and others (Figure 22).

Figure 22. The Petronian frigate.

Naturally the frigates of Peter I were no icebreakers in the modern sense of the word. However, these ships were adjusted for sailing in the ice. The oval plating of the middle frames secured to a considerable degree the hull of the ship the capability of decomposing the energy coming from the compression of the ice into vertical and horizontal components. The bow part of the frigates had a fairly slanting and quite firm stem.

With the further development of navigation, with every oncoming day, the more painfully was felt the deficiency in the more perfected means of navigation in ice. It was obvious that the struggle with the ice conditions is not possible without a ship with a firm hull and a sufficiently powerful mechanical motor.

In 1815 the steam engine, with 4 hp had been set up on an ordinary Tikhvin canoe. As the test of this steamboat conducted on Neva River, in clear water it sailed successfully, in the sludge it ran with difficulty, however, considerably better than the sailing vessels. To sail in young ice covers this steamboat, with a weak hull and a 4-hp motor, naturally was not qualified, but its construction determined the ways of development in the construction of the icebreakers. Many sailors and shipbuilders realized that if one could strengthen the solidity of the hull and the power of the machinery, the ice impediments could be overcome with the aid of a steamship.

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Numerous inventions had been proposed and carried out. In the bow section of the vessels circular saws were installed to cut the ice. Further, solid wooden or metallic bands or plows were installed, consisting of two connected curved iron blades forming in the upper central part a sharp rib. They used also the so-called "icebreaker shoes" (Figure 23), the vessels with wheels breaking up ice. These were installed in the bow part of the hull (Figure 24), together with certain icebreaking outfits (Figure 25) and many other things. But all these installations were destroyed as soon as they contacted the ice.

Figure 23. The icebreaker shoes.

Figure 24. Ship with ice-crushing wheels.

Figure 25. An ice-crushing icebreaker outfit.

After numerous attempts to build equipment for the breaking of the ice it had been recognized that the most successful was an icebreaker vessels which mounts, due to the special shape of its bow part, on the ice and breaks it through by its weight. The idea of building an icebreaking ship was carried out for the first time in 1864, by a merchant and ship owner from Kronstadt, Mr. M. O. Britnev.

As his icebreaker he used the small vessel "PILOT", 26 meters long with a metallic hull and steam engine, 85 hp strong. The bow part of the vessel was especially cut for its rising on the ice surface (Figure 26).

Figure 26. "PILOT" steamship before and after its reconstruction.

Later a second similar vessel was built, however, smaller in size, carrying the same "BOY". In a few years in order to maintain communications between St. Petersburg, Oranienbaum and Kronstadt in the inter-navigational period by the Oranienbaum Navigation Company, two icebreakers were built on the same principles, under the names of "LUNA" and "ZARYA" with steam engines of 250 hp capacity each.

In 1865 the Russian engineer Eyler rebuilt the gunboat "OPYT" and equipped it for ice-breaking operations (Figure 27). In the bow part of this vessel six cranes and six winches had been installed. With the aid of the winches and cranes weight of 20 to 40 poods /TN: 36 pounds to a pood/ had been dropped. Besides this from the bow part of the hull a pipe was stuck out through which the blasting of the ice was effected. The weights and blasts were crushing the ice, however, the vessel did not have sufficient power to push the broken up ice slabs out of its way.

Figure 27. The gunboat OPYT.

In 1871 the Germans became thoroughly acquainted with the operations of the Russian icebreakers "PILOT", "BOY, "LUNA" and ZARYA", puchased the blueprints of the icebreaker "PILOT" and built similar ships, but with a different shape of the hull. These icebreakers with the capacity of 30 to 600 hp, became known as the Hamburg icebreakers. They were distinguished by a spoon-shaped form bow part of the hull, and abutting and slanting stem, connected with the keel. The Hamburg icebreakers were used for conduction of ships in the ice, and also for the struggle with the spring floods in the rivers Elbe, Oder, Trave, Vezer and others.

At the same time the icebreakers appeared on the Great Lakes in the United States, and then in Finland, Sweden, Denmark and Norway.

However all these icebreakers were operating only in the

internal seas, rivers and lakes. The navigation in the Arctic Seas was developing rather slowly. Only in 1876 special commercial trips were introduced from Europe in the estuary of Enissey River, while in 1877 began in the same direction the transportation of the goods by sea.

In 1895 - 1897, by the order of the Russian Government the icebreaker barges "BAYKAL" were built for transportation of the rolling stock through the Baykal Lake. The power of "BAYKAL" came up to 3,750 hp (Figure 28) and that of "ANGARA" up to 1300 hp.

Figure 28. Icebreaker barge "BAYKAL".

At the same time another barge of this type call "SARATOVSKIY LEDOKOL" (The Saratov Icebreaker) was built with 1500 hp for transportation of the rolling stock across the Volga River. ~~Barges for trains were making their way through the ice by~~ breaking through their own channels.

Thus toward the end of the XIX Century the icebreaker fleet was developing all around, however a powerful heavy duty icebreaker, which could contend with heavy ice covers, was not yet in existence.

The idea of building such an icebreaker originated in the mind of the resourceful inventor and progressive Russian Admiral S. O. Makarov. In 1892 he for the first time set up the objective to investigate the Arctic Ocean, with the aid of a powerful icebreaker. By this operation he intended to reach to the North Pole, secure a systematic steamship communication in the summer season with the ~~xxx~~ rivers Ob and Enissey, and in winter with Petersburg.

"No other nation is so interested in the icebreakers as Russia is" - wrote Admiral Makarov: "The nature chained our seas with ice covers, but the technology provides now-a-days a huge means and one should admit that at the present time the ice cover no longer places

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unsurmountable obstacles to navigation."[1)]

> "I know, - spoke Makarov, - "how one can reach the North Pole: one must build an icebreaker of such power that it could crush the polar ice masses - that requires a million rubles, but that can be done".

The idea of Admiral Makarov to build a powerful ice-breaker equipped with all the properties of a sea vessel and at the same time being capable to crush heavy Arctic ice masses, was met with a powerful opposition of the Czar's officials. Only the exceptional insistency/e and energy of Makarov and also to a considerable degree, the support of D. I. Mendeleev helped to overcome this opposition.

By the projects and blueprints of Admiral Makarov, who was actively assisted by the shipbuilding engineers Afanas'ev and Runeberg, on the 21st of February 1899, the construction of the first heavy duty icebreaker in the world was completed. It was given the name "ERMAK", had a power of 10,000 hp, with four steam engines, with one bow and three stern propellers. Its appearance introduced a new epoch in the field of the icebreaker construction.

"ERMAK" differed from all the previously built ice-breakers by its considerably larger size, power and number of propellers, as well as with the structure of the hull. In the hull of the icebreaker ERMAK the ice-breaking and ice-cutting properties combined into a successful group. The straight line stem of an increased strength with a slant under the angle of 25° to the horizon made it possible for "ERMAK" to run with full momentum on the ice a whole lot further than the previous icebreakers. As it rises on the ice "ERMAK" developed its vertical pressure with more than 800 tons and could break up a fairly heavy ice.

In 1899 Admiral Makarov completed the first trip on board the "ERMAK" in the ice regions of the Polar basin. It was obvious that the active navigation in the Arctic ice

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Footnote 1: S. O. Makarov, "ERMAK in Ice", page 45.

had actually begun. However, even the most powerful icebreaker known at that time was not sufficient. The polar seas were still not sufficiently studied, supporting bases were still inexistent, there were no reports, radio stations, aviation, neither ice reconnaissance, nor ice prognostication. The experienced sailor groups were still absent, especially the leaders in the ice navigation, and the most important of all the Czarist Government did not assist the scholars and sailors in the conquest of the Arctic.

While forcing heavy ice masses "ERMAK" suffered serious damage to her hull on two occasions. On the 13th of October 1901 following the report of an ineffective and illiterate committee, the Emperor made the decision to limit the operations of the icebreaker for conduction of the vessels in the ports of the Baltic Sea and to turn it over to the jurisdiction of the Committee on Port Affairs. Admiral Makarov was removed from his field of polar navigation.

In 1899 in connection with the rapid development of the Port of Nikolaev and the increase of its freight returns the Ministry of Transportation ordered an icebreaker vessel to be built in Sweden - "Icebreaker No. 1" 700 hp strong. It was constructed by the plan and blueprints of the Russian engineers, who had directly supervised its construction. This icebreaker maintained navigation in the Port of Nikolaev all the year around.

The Russian Government had been laboring under the opinion at that period that the icebreakers should be built only for the ports and rivers connected with the interior seas of the country, while the use of the icebreakers in the polar seas, was quite pointless. But progressive scholars and navigators of that time had different opinions. The talented Russian scholars, shipbuilders and navigators kept working with determination on the solution of the problem of the conquest of the Arctic and on overcoming the ice masses of the Polar Seas. More particularly the great Russian scholar Dmitriy Ivanovich Mendeleev devoted a great deal of attention to this problem.

In his report dealing with the investigation of the

Northern Polar Ocean, submitted to the Minister of Finances S. YU. Witte on the 14th of November 1901, Mendeleev wrote:

"The efforts of Peary, Nansen and other investigators to reach the North Pole on dogsleds and skis, in my opinion, should be considered as one of the most remarkable feats of sport, but such as are unable to produce any serious practical results. It is necessary and especially desirable for the direct industrial benefits of the humanity to conquer the polar ice masses as well as for the triumph of knowledge and science. The victory will be considered complete, however, only at a time when a vessel equipped in Europe, will pass in short time and directly to the Bering Strait over the 2500 versts /TN: 1.067 km unit of measure/ where so far not a ship passed, nor human foot has ever stepped. However, if one ship succeeds soon to carry out this task (that is, not more than one month) intelligently and with conviction, (that is, by keeping to that course which is desirable) in a short period of time, probably it will become possible for us to establish, if not a continuous, then at least of the regular sailing."

Further Mendeleev wrote: "The first example will be an indicator of those tactical methods with which, following the proper improvements, we shall be able to achieve this objective, and if with the power of technology, the most ancient minerals are broken through the massifs of mountains, then the ice cannot keep human beings away when they will use the proper means for the struggle with them. As a result, naturally, a new form of special vessels and a new selection of equipment will be necessary".

For the execution of the experimental operations D. I. Mendeleev asked for a contribution of 150 - 200 thousand rubles. However this request had been denied ~~the~~ him.

During the time of the Russo-Japanese War in 1904 - 1907 it was necessary to lead the Russian naval units from the Baltic Sea into the Pacific Ocean. In the absence of a sufficiently powerful icebreaker fleet and experienced men

familiary with the sailing conditions in the Arctic Ocean, it was necessary to send the vessels over the tropical seas. The tragic results of this voyage, in the course of which almost the entire Russian Navy perished, forced the Navy Department to start investigating the Arctic Sea lane. A government committee "dealing with the problems of Siberian Seaways to the Far East" was organized under the chairmanship of A. I. Bil'kitsky. In Petersburg at the Neva Shipyard the construction of two expedition icebreakers was initiated under the names of "TAYMYR" and "VAYGACH" which had been completed in 1909.

Somewhat earlier in 1907 in the White Sea the icebreaker steamer "XI "NIKOLAY" appeared as a property of merchant Maslennikov. This steamer made it possible to prolong the navigation period in the Archangel port on an average for two months in fall and one month in spring, and was of great assistance in the struggle with the spring floods along the Northern Dvina.

Beginning with 1910, "TAYMYR" and "VAYGACH" undertook navigation trips into the polar seas where the hydrographic studies and other scientific operations were carried on under the command of B. A. Vil'kitsky. In 1910 the icebreaker, "PETR VELIKY" was built and equipped with both stern and bow engines, with 1265 and 2660 hp, respectively. This icebreaker was successfully used for the ice convoys in the Port of Riga.

During the period of the First World War (1914-1918), for the first time a mass convoying of ships through the ice was undertaken. The Black Sea and the Baltic Sea were blocked, while the Archangel Port was the only one through which one could get freight from abroad. Therefore the problem of equipping of this port with icebreakers emerged in all its severity, in order to prolong the navigational period. In connection with this 22 special steamships of the icebreaker class were purchased and built, in the number of which were the relatively powerful icebreakers (with a capacity from 3 to 7.5 thousand hp): "KNYAZ' POZHARSKY" with 6,000 hp, being changed in consequence to ~~XMKKK~~ "MAKAROV", "TSAR' MIKHAIL FEDOROVICH" with the power of 4.5 thousand hp, to which in 1918 the name "VOLYNETS" was given, "PEARL GRAY" with 7,000 hp

which was renamed at first to "KANADA", and then into "III INTERNATIONAL", and, finally, into "F. LITKE", and others.

A certain part of the icebreakers and ice-breaking vessels perished in the war, while the others have been called abroad by the interventionists and White Guards.

The youthful Soviet Republic got ten large icebreakers as a legacy of the Czarist Government, with a total of 51,200 hpx: "ERMAK", "KRASIN", "LENIN", "F. LITKE", "MAKAROV", "TRYVOR", "OKTYABR'", "SILACH", "PURGA" and "TOROS"1).

After the Great October Socialist Revolution for the first time in the history of our country the problem of conquest, cultural and economic development of the far remote provinces of the Soviet Union was set up in its entirety, and in their number also the area of the Arctic regions. This required a minute study of basic icebreaker business. The works bearing on the study of the icebreaker operations were concentrated since 1922 in the Leningrad section of the Higher Technological Committee in the subdivision of the Commercial Transportation. Simultaneously the study of the icebreaker

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Footnote 1: The icebreaker "KRASIN", which was named before the Revolution "SVYATOGOR", arrived from England only in 1922. The icebreaker "LENIN" was named previously "ALEXANDR NEVSKY", the icebreaker "MAKAROV", as stated above, bore the name of "KNYAZ' POZHARSKIY", while "F. LITKE" - was "KANADA", the icebreaker "OKTUABR'" - was previously to that "REVEL'SHTADT". The other icebreakers and ice cutters kept their original names.

All these icebreakers were within the jurisdiction of the Leningrad Commercial Port and were maintaining the navigation throughout the winter, since Tallin and Riga belong to Estonia and Latvia, with whose ports we had no contacts.

subject has been tackled from many points of view at the Peoples Commissariat of Foreign Trade.

In such a manner the great scientific work was initiated in regard to the thorough and minute study of the icebreaker fleet, formation of the ice, as well as of the different ice conditions. At the same time the generalization and systematic study of experience of the icebreaker convoying of vessels were engaged in.

In 1925 in connection with the expansion of its activity the Northern Scientific - Industrial Expedition was organized into an Institute for the Study of the North, and in 1930 - it was changed into the All Union Arctic Institute. Up to 1932 the systematic navigation in the western part of the Arctic Sea area was carried only up to the estuary of the "Yenissey" River, and in the eastern portion of it up to Kolyma River. The passage along the entire course of the Arctic Sea was considered impossible, within the limits of one year. However, theories were worked out for precisely such kind of navigation. The sailing course was studied more thoroughly, the polar stations had been set up on the Franz Josef Land, Novaya Zemlya, at the Capes of Zhelaniya and Chelyuskin. The complements of the polar mariners and investigators were growing in numbers, the experience of navigation amid ice conditions kept accelerating. The ice-breaker steamship "SIBIRYAKOV" under the command of Captain V. I. Boronin successfully completed the full navigation trip from the west to east along the course of the Arctic Seaway within 65 days.

Following the navigation by "SIBIRYAKOV" the Soviet Government decided to equip the soonest possible ships for the final conquest of this course.

In December 1932, attached to the Soviet of Peoples Commissars of the USSR a special government organ was set up - the Main Office of the Arctic Sea Route.

In the following years considerable progress has been made in the construction of an icebreaker fleet. In 1937 - 1941 on Soviet shipyards the large icebreaker "I. STALIN",

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"L. KAGANOVICH", "A. MIKOYAN", and "V. MOLOTOV" have been built.

The effort at the conquest of the Arctic Seaway Route was not discontinued even during the years of the Great Patriotic War. At the present time the Soviet icebreaking fleet has grown out of proportions, both in the number and the power of the ships. We have by this time remarkable complements of specialists coming from a large number of professions, connected with the technics and tactics of navigation in ice, - the sailors, fliers, shipbuilding, airplane builders, hydrologists, radio experts, synopticians, hydrographers, port specialists and many, many others. They are systematically improving their skill, - they are accumulating knowledge and experience. With each coming year the requirements to the vessels of navigation in the ice conditions are raised. The same applies to the complements which are organizing and practically carrying out the convoying of ships through ice.

Section 7. Classifications of the Vessels Navigating in the Ice Areas.

By the nature of locomotion in ice conditions two basic classes of ships of ice navigation are distinguished:

The ships of active navigation in ice conditions, assigned for opening up the sailing tract in a compact ice field or in the consolidated crushed ice (the linear and auxiliary icebreakers, special transporting vessels and the icebreaking barges);

The ships of passive navigation in ice conditions, which which can navigate in ice areas independently only when water lanes are available or following through the channel laid out in the ice fields by a vessel of active navigation.

These two basic classes of ships of sailing in ice are

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divided also by the navigation areas, by the nature of special assignments and by the conditions of operation, and also by the method of overcoming the resistance of the ice and the shape of the hull connected therewith.

By the area of navigation the ships sailing in ice conditions are subdivided into three classes:

Sea vessels which can safely sail in the open sea; the roadstead or lake ships sailing in the area of the port waters and lakes; the river boats.

The vessels navigating in ice are divided into categories by their assignment and conditions of the operation.

The large icebreakers (Figure 29) the assignment of which is to open up a canal in the solid or compressed crushed ice for the guiding of the other vessels; the independent decision concerning tactical tasks is placed on the heavy duty icebreakers, both for the convoying of ships in the internal freezing seas, and in the sailing trips across the Arctic Ocean.

Figure 29. Diagram of the large icebreaker "I. STALIN".

The auxiliary icebreakers (Figure 30), which complete some auxiliary work dealing with the formation of caravans, towing of the guided vessels, delivery of provisions, workingmen, etc., while the heavy duty icebreakers are convoying the ordinary ships. The auxiliary icebreakers will chip off the area of all the vessels that got stuck in the ice, and are utilized along with the maneuvering port icebreakers (Figure 31) for operations in the ice areas of the port waters, by convoying the ships to their moorings, by transferring the vessels from one mooring platform to another, etc.

Figure 30. Diagram of auxiliary icebreaker "PETR VELIKIY".

Figure 31. Diagram of the port icebreaker with the stern propeller.

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The large, heavy duty icebreakers and those of the auxiliary type are carrying out their shipping functions in exceptional cases and on not a large scale, when, because of heavy ice masses, it is not possible to escort into any area a freight vessel for delivery of the freight and hands.

The heavy duty large icebreakers and those of the auxiliary type, are the most widely diffused types of the vessels used for navigation in ice conditions and are finding their application in all the freezing seas of the USSR, of the United States of America, of Canada, Germany, Norway, Sweden, Denmark and Finland.

The icebreaking barges are assigned to transport the trains, the automobiles and truck transportation and also freight and passengers across the ice areas of the frozen rivers, lakes and straits. This type of ships for navigation in ice conditions is strictly specialized and is used in the USSR (on Baykal Lake, on Volga, Amur, Neva Rivers) in Denmark, Norway (chiefly in the rocky islands) and in the United States of America (on the Great Lakes and large rivers).

The expedition boats for navigation in ice conditions are assigned for the study of the polar basin. Such vessels are equipped and provided with everything that is necessary for the execution of the scientific - investigating operations in oceanography, geography, biology, hydrology, hydrobiology, etc. The expedition boats can be those of active ice navigation with solid steel hulls and powerful machinery capable of forcing the ice fields and compact crushed ice masses, or of the passive navigation, that is, of relatively small size, frequently with a wooden hull. These sailing - motor vessels are adjusted for navigation in thin ice areas.

Hydrographic ships of ice navigation are used for work bearing on description of the polar seas and those, for setting up of the sailing directions, sea charts and blueprints, installations and effectuation of the sailing set-up of various kinds. Hydrographic vessels in the same way as the expeditionary ones can be both those of active or passive ice navigation.

The magneto-metric ships of ice navigation are adjusted for the study of the terrestial magnetism in the polar basin;

the hulls of such vessels usually are made of wood, all the metallic equipment and components are made of non-magnetic materials. This type of vessel is of the sail - motor type.

The hunting vessels of the ice navigation are used for the industry of the sea animals. Usually these are wooden ships of small dimensions, with a solid make-up of the hull and with relatively small internal combustion engines, 3 to 4 hundred hp. At the present time for the industry of the Greenland seal in the White Sea they ~~ar~~ began to use the ice-breaking transportation ships of the type of "DEZHNEV", which operates under the guidance of large and auxiliary icebreakers.

Transportation vessels of the active and passive navigation in ice conditions. The former (Figure 32) are used for transportation of freight and passengers. Vessels of this type are less frequently used than the icebreakers, and are operating chiefly in the USSR, Canada and Finland.

Figure 32. Diagram of a freight vessel for active navigation in ice conditions.

The freight vessels of the active navigation in ice conditions are possessed of solid hulls and are provided with powerful engines. They have a long operation range, which considerably contracts the useful freight capacity of the vessel for the benefit of increased supplies of fuel and water, the machines of great power, which also require a large complement of the crew. Thus, both the construction and operation of the freight vessels of active navigation are considerably more expensive, than the construction of the usual freight vessels. Besides this the sea-going properties of the freight vessels of active navigation in free water, especially in stormy weather, are worse than in the case of the ordinary ships because of the ice-breaking adjustments of the hull.

An especial need for freight vessels of the active ice navigation developed in the USSR, in connection with the

development of the northern sea navigation lines. Due to the particular ice-breaking formations, a considerable increase in the solidity of the hull and power of the machinery, such vessels can sail independently in broken-up ice and can force the none-too-heavy ice dams.

The freight vessels of the passive navigation in ice conditions differ from the usual freight vessels with the increased solidity of the hull, especially of the front part, with the greater power of the machinery and reinforced construction of the rudder and propellers. Ships of this type are widely used in all the countries where in wintertime the ports and approaches to same are locked in ice. The freight vessels of the passive navigation in ice conditions have essential advantages over the usual vessels of the freight-carrying fleet: due to the solidity of the hull and ~~fx~~ fairly powerful machinery they are subject to ice-caused injuries to a much lesser degree and can sail in the channels behind an icebreaker.

Quite properly the best type of freight-carrying vessels for navigation in the ice conditions are the ships of the active navigation in ice, however they cannot replace fully the freighters, because of their relatively small freight-carrying capacity and high cost.

Section 8. The types of Icebreakers and the Principles of Their Operation.

The present-day icebreakers are subdivided into three basic types as far as their principle of operation and effect on the ice are concerned.

The icebreakers, or otherwise called ice-cutters, which cut into the ice in a manner of a wedge (Figure 33, I and II). The most efficient are the ice-cutters in crushed ice or in the ice grits when the ice mass is not consolidated. The ice-cutter shoves apart the ice with its wedge-like hull and in this way it clears the route.

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Figure 33. Diagram of an ince-cutter. The lateral view and the theoretical blueprint.

As an example of such icebreakers, ice-cutterx should be taken "F. LITKE" and "PRONCHISHCHEV". In the case of "F. LITKE" icebreaker the bow part forms a 90° wedge at the water line and 13° at the keel.

The Hamburg icebreakers (Figure 34) are possessed of a spoon-shaped form at the bow part of the hull with smooth lines of the hull; the front part of the vessel crawls up on the ice cover, and the latter breaks under the weight of the icebreaker. The Hamburg icebreakers, however, are blighted with essential defects. Due to the rounded lines of the hull the sea-going properties of the vessel are deteriorated. Besides this, the navigation of the icebreaker in the fine ice floe or in the ice grits is made difficult, since the ice accumulates in large quantities right before the bow of the icebreaker. The spoon-shaped bow will render the sailing of the icebreaker by its course difficult, although it provides a light maneuverability during operations in the ice.

Figure 34. Diagram of the Hamburg-type icebreaker.

The icebreakers of the type "ERMAK", in which both principles of ice-forcing are utilized as indicated above (Figure 35, I and II).

Figure 35. Diagram of the "ERMAK" icebreaker. The lateral view and the theoretical blueprint.

At the present time still another type, the third type of icebreakers is under construction, and they are by far the most popular. The bow formation of the hull of the present-

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day icebreakers has the shape of slanting sharp wedges, which makes it possible both to cut and crush the ice.

By the disposition of the propellers there are icebreakers with the stern and bow propellers. By the number of propellers the icebreakers are made with one, two, three and four propellers.

The icebreakers with just a single stern propeller, are used very rarely and chiefly for the operations around ports. These are the towing-boat icebreakers of small capacity. Their chief deficiency is their poor maneuverability in comparison with double propeller vessels. Even though on a single propeller, an icebreaker may one may deploy almost on the spot, however it takes relatively long time, many maneuvering moves and it requires also a great skill of the pilot. Moreover the turns of a single propeller vessel are always better in the direction of the propeller turn, since on the rear motion the bow of the vessel under the effect of the propeller has the tendency to turn in the direction of the latter's rotation.

The second essential deficiency of the single propeller icebreaker is the fact that in case of damage caused to the propeller shaft, to propeller, or even to one of the blades of the propeller, the icebreaker is put out of commission. Even though on a single propeller ship the propeller is better protected from ice injuries through the lines of the hull and the frame of the stern post, than on a double propeller ship. In operations through ice, injuries of this kind occur quite frequently.

The icebreakers with two stern propellers are also of the auxiliary and port types. As a rule they have better maneuverability than those with a single propeller, and have a smaller draft. In the case of several propeller icebreakers the propellers are disposed in front of the rudder, symmetrically on both sides from its diametrical plane and have an opposite run (Figure 36). Due to this, by running one propeller forward, and the other backward, in light young ice cover one can turn the icebreaker on the spot at any desired angle. In heavier ice it is almost impossible to deploy in such a manner except with gradual movements of the vessel now forward

and again backward, since the icebreaker cannot overcome the ice cover.

Figure 36. Disposition of the rowing propellers in the case of a two-propeller icebreaker.

In so doing one should take into consideration that at the simultaneous work of the propellers of one hull side forward and the other backward, in some icebreakers the deployment is very slow. Therefore it is preferable to give it a forward and backward run alternatingly.

The second very essential advantage of the icebreaker with two propellers consists in the fact that in case of damage to the propeller and its incapacitation, or that of the propeller shaft or engine, one can continue to operate with one engine, even though with lesser efficiency, and also keep the icebreaker on its course with the aid of the rudder. In so doing the icebreaker develops about two-thirds of its speed compared to its run with both engines. Thus, for instance, if the icebreaker at 64 revolutions and operation with both engines in free water, develops a speed of 12 knots, then while operating with the same number of revolutions, but by relying on one engine alone, it will develop a speed of 8 knots per hour.

The position of the rudder in such cases depends upon the conditions of work, but for keeping the boat on its charted course, it is sufficient to set, usually, the rudder 5 - 10° away from its diametrical plane. If the wind (or the strongest solid ice) is on the side of the immobilized propeller, it may happen that the icebreaker will turn so far windward or to the side of the weakest ice cover, that it will be impossible to keep it on its course with the aid of the rudder.

Powerful large icebreakers are now-a-days being built with three stern propellers (Figure 37).

Figure 37. Disposition of the rowing propellers in the case of a triple-propellered icebreaker.

Originally the purpose of construction of triple-propellered icebreakers consisted in the fact that for the maximum effect of performance it should be brought to its peak efficiency in the ice conditions, and also for the sake of the range of icebreaker's operations. It was assumed that on long trips across free water or in weak ice covers it ~~mimg~~ will be possible to operate only with the center machine with the stop side propellers, or with two side propellers, when the center propeller is out of commission. Thus, even with the sufficient amount of power, the consumption of fuel could be reduced, and that means to increase the range of the ice-breaker's operations.

However, this assumption does not fully justify itself. In the course of time some other advantages appeared on board the icebreakers with the installation of three engines. In the first place, that provides a greater life span of the icebreaker: if one engine is put out of condition, two more are still in good order, due to which around 0.9 of the former course is preserved. The icebreakers "ERMAK" and "KRASIN" while only the center engine was in operation (while the side engines were at standstill) develops a speed of six knots per hour. The icebreaker "ERMAK" in 1938, while pulling out the icebreaking steamers "SADKO" and "MALYGIN" from amid heavy ice masses at the latitude of 83°05' N, which were just drifting along, lost both lateral propellers. Operating only with the center engine "ERMAK" overcame over a distance of 200 miles the heavy ice masses and pulled out both steamers from their drift. Moreover in clear water "ERMAK" was developing speed of nine knots per hour. Its maneuverability did not differ in any way from such properties of a usual single-propellered sea vessel.

The second advantage of the three-propellered icebreaker consists in the fact that due to the lesser height and weight of its engines, it's draft can be made lesser than in the case of double propellered icebreaker of the same power and with

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the machine installation of the same type.

Further due to the more convenient disposition of the engines the icebreaker is divided into a greater number of compartments., by which move its greater life span is secured as well as the disaster of sinking made less probable.

Finally, the central propeller of the icebreaker is better protected with the frame of the stern post and by the outline of the hull from damage through ice.

However, to the basic efficiency of a three-propellered icebreaker should be ascribed the fact that its maximum speed is somewhat lesser than in the case of a double-propellered ship of the same size and of the same power of the machines. The fuel consumption on small speeds (when all three engines are operating) is in the case of three-propellered icebreakers somewhat larger than is the case with a two-propellered vessel of the same power capacity. At large speeds the fuel consumption is the same. Furthermore on a three-propellered icebreaker the tubes are considerably more complicated and there is a larger number of auxiliary mechanisms. Three machines require more engineering crews, hence, the operation cost is increased.

The central propeller of the three-propellered icebreaker is disposed in front of the rudder, while the lateral propellers on both sides of the stern in the same plane, are usually closer to the bow than in the case of the two-propellered icebreaker. Therefore if the icebreaker is running under one or three engines, the maneuverability effect of the central propeller is the same as in the case of the single-propeller ship.

In the case of the three-propellered icebreakers, all three propellers are usually of the same size. In the meantime the capacity of each of the engines is smaller than in the case of two-propellered icebreakers of the same power capacity. It would seem that it is more difficult to deploy with that by opposite turns than on a two-propellered icebreaker. As a matter of fact that is not so. The effect of the center propeller is so great that the maneuverability of

the three-propellered vessels is by far not worse than that of the two-propellered vessels. After a full stop the three-propellered icebreakers, unless the forward run is given by the central engine, will promptly deploy even better than the two-propeller icebreakers.

If the rudder goes out of commission in a three-propellered icebreaker, one can still steer by the lateral engines but with difficulty. The work of the central propeller can be fully directed to the forward run of the icebreaker, while the lateral machines can regulate the direction of the movement. This is very important since the operation of the rudder which has but a small surface, is insufficient while sailing in the ice areas, and the steering of the icebreakers in maneuvering, is effected by the engines. It is not advisable to increase the surface of the rudder on icebreakers and vessels of the ice navigation, since with the increase of the surface of the rudder also the hazards of its injury are increased.

The icebreaker with three propellers, when ~~dere~~ deprived of the rudder, can under equal conditions, sail with a greater speed than the icebreaker equipped with two propellers.

However, one should note that if on a three-propellered icebreaker the rudder comes out of commission, while it is assisting the ship through the ice channels, the icebreaker cannot keep up its convoying work.

Such an icebreaker cannot complete even a long sea trip, especially in strong wind and while the sea is choppy. With the round shape of their hull, the icebreakers are subjected to hazards and without the rudder action they can circle.

Besides this there is time enough to alter continuously the action of the engines which are needed in order to keep the icebreaker in her proper course.

Thus the icebreakers "KRASIN" and "ERMAK" are hard to steer while the central propeller is halted. On the icebreaker "KRASIN", while sailing in a wide fjord in the area of Bergen, the central engine went out of commission. The icebreaker on

navigating with the lateral engines at an equal number of revolutions, started to slant, deviating by 9 - 10° from its course in one direction or another. The captain of the ship was forced to stop the vessel until the repair of the central engine was made.

In 1953 during the period of the Arctic navigation on board the "ERMAK" the end shaft of the central engine was wedged in the deadwood tube. That immediately upset the normal steering of the ship. Even though the icebreaker kept conveying the ships through the ice, it worked on a very low, reduced tempo, since it steered badly with the aid of the rudder and lateral engines.

When sailing through solid, smooth and level ice areas the securing tendency of the icebreakers is considerably reduced. When chipping off the ice from the ships stuck in the ice tract, and when it approaches the ships sailing in shoals or in hazardous places, the three propellered icebreaker usually operates on the central engine. By giving it a rear run with the lateral engines at the right moment, one can stop the icebreaker quite promptly. However, to bank on the idea that the icebreaker can be stopped in proper time when running into a shoal, naturally, is impossible.

When the speed and the position of the rudder are even, the circulation range on the side will be the slightest, if only the central machine alone will run forward. When leading the ships through the ice channels in the majority of cases the icebreaker must work with high revolutions of the central engine. If the lateral engines are operating on a slow run, the central engine must work with second or full gear in order to assure a better steering. However, when lateral engines are operating on the medium run, the central engine must work at full speed.

If the icebreaker cannot overcome the ice with its bow section, it will easily overcome it with its stern, operating in this case not only with its striking power, as much as with the stream of water coming from the propellers. However, proceeding forward with the stern, it is difficult to hold on to the course. That is why the forcing of the ice

with the stern is resorted to very rarely. In the majority of cases such method is used when clearing the ice from the ships with rear runs.

Besides the icebreakers with the stern propellers, at the present time the icebreakers with the bow propellers became quite popular. The bow propellers when the ship runs forward, pumps out, while in motion, the water from under the ice and pushes it under the body of the ship, thus forming a near vacuum under the ice. The ice deprived of its natural support, will more easily break under the effect of its own weight and the entering bow section of the icebreaker. The stream of the water stirred up by the propeller, pushes, in addition, the broken up ice under the bottom and stern of the icebreaker. As the bow propeller is giving the rear run, the water stream is directed forward, and by washing the ice, breaks it. The best effect is achieved through such operation in the non-freezing hummocks.

The water stream directed forward from under the bow propeller washes apart and removes also the snow which, quite frequently, is stored on the ice surface with a heavy layer, or the crushed ice, turned so to say into a dense ice grit material, which exerts a considerable resistance to the movements of the icebreaker. As an example one may describe one of the winter campaigns based on the leading of the vessels through the ice channel to the commercial port of Leningrad.

Due to heavy icebreaker traffic the crushed ice turned into a dense grit mass, becoming under the effect of the low subzero weather, almost seven meters thick. This was caused by the continuing movement of the icebreakers through the open portion of the sea channels one tract of nine miles between the end of the dam 114 and the eastern roadstead of Kronstadt. This mass of ice was not carried away from the canal either by the current or the wind, and gradually built up a heavy obstacle for even such icebreakers as "ERMAK" and "KRASIN". It also happened that in the mass of the crushed ice all three stern propellers of "ERMAK" and "KRASIN were wedged in.

However, the icebreaker "LENIN", being equipped with a bow propeller, kept to work quite successfully in these

complicated conditions even at the rate of number of propellers' revolutions below the standard.

The icebreakers with the bow propellers have another important advantage - a very good maneuverability. Besides the regular smooth runs forward and backward, and also turns to the right and to the left, the icebreaker with a bow propeller may also shift in the direction perpendicular to its diametrical lane, by way of balancing of the work of the bow and stern engines, providing the captain has the proper skill to steer. This property of the icebreaker with the bow propeller is being successfully used while being moored in narrow places to the mooring platforms and other ships. The icebreakers with the bow propeller showed excellent results in operations in ice in the Okhotski, Baltic, White and other seas, on the rivers and lakes of the USSR, and also on the Great Lakes of the United States of America.

At the present time the icebreakers with one and two bow propellers are met with in combination with one or two stern propellers. The icebreakers with one bow and one stern propeller are of the type used in the ports and have the capacity of 4,000 hp. The icebreakers with one bow and two stern propellers belong, in the majority of cases, to the class of the port icebreakers, but depending upon the power ofthe machines and solidity of the hulls, can also be used as first-class large icebreakers.

So far only the icebreaker barges have been built with two bow propellers, although there is every ground to believe that such icebreakers in a variety of ice conditions will be operating more successfully than the icebreakers provided only with one bow propeller, by pushing the crushed ice not under one but under both sides of the icebreaker, in case two propellers are installed.

The USSR ordered in Finland at this time three icebreakers with two stern and two bow propellers, which have been actually built.

The icebreakers with the bow propellers are also blighted with their own deficiencies. The basic deficiency consists

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in the fact that the bow propeller, as any other abutting underwater part, is subjected to frequent injuries. When operating in heavy ice conditions not only the propeller can be damaged, but also the shaft, deadwood and even the bow engine. Besides this when anchored at the time of strong ebb and tide currents, or in heavy wind, the icebreaker circles around the anchor.

Section 9. Peculiarities of the Present-Day Icebreakers.

The present-day icebreakers are marked by sharp formation of bow parts of the body and by a slanting middle angle of the inclines of the buttocks which secures a great vertical pressure on the ice. In the case of the icebreaker "ERMAK", when the bow rises upon the ice to a height of 2.5 - 3.5 meters, it will come up to 800 tons. The stem of the icebreaker is cut under 25 - 30° angles to the horizontal, while the sides incline 10 - 20° toward the vertical.

Due to the inclining position of the stem the icebreaker is in a position, to break the ice with vertical pressure, without any damage. The middle frame of the icebreakers is shaped like an egg (in the case of the icebreaker "ERMAK" the form comes close to a trapeze) with an incline of the side 15 - 20° to the vertical, which makes it possible to break the ice by the sides of the hull. Besides this, due to such formations the icebreaker has more force of resistance to the vertical blows. When it gets compressed by the ice masses the vertical components stress the icebreaker slightly upward. In the case of icebreakers the length is reduced and the width is increased, in comparison with the regular vessels. This provides the formation of a fairly wide channel for the convoying of ships; for an effective and safe passageway in the ice areas the width of the icebreaker should not be less than ~~as~~ 1.3 of the width of the vessel being convoyed. In practice of the ice towing of the vessels it happens quite

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often that when the ships, the hulls of which were wider than the hulls of the icebreakers, were considerably damaged when led through heavy ice tracts.

The icebreakers provide, so far as possible, a great draft for convenient disposition and protection of the propellers.

The side emerging above the water rises in height which secures the vessel the needed reserve of buoyancy. In the normal conditions this is of no essential significance and is planned for a case of damage to the hull. The relation of the draft of the icebreaker to the height of the sides usually moves within the limits of 0.65 and 0.80, and for the shallow draft icebreakers between 0.55 and 0.60.

For protection of the propellers and the rudder, especially in case of rear run, the stern of the icebreaker is made like that of the cruiser with the incline of the afterstem by 20 - 25° and especial excision for the towing of the vessels close to each other and for operation of the "tandem" method.[1]

The lateral parts of the stern are protected from damage with fenders made of steel cables, and also by buffer fenders disposed in the excision part of the stern and on abutments (section angles). The icebreakers have round outlines of the hull, the relation of the width to the draft in same fluctuates between 2.5 and 3.0 meters, while the metacentric height is 2.5 - 4.0 meters. In addition as the side keels are absent in the icebreakers. These, namely the side keels, reduce in the freight vessels considerably the rolling momentum. This is the cause of heavy rolling of the icebreakers on stormy seas.

The icebreaker as every other vessel of sailing in ice conditions, must have a great solidity. Its engine installation itself must have an increased solidity, since in the ice

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Footnote 1: Towing method in which the towed vessel sticks into the towing one and runs by its own machine.

navigation usually a great number of reverse runs is practiced; one must operate with sharp alternating methods when passing from the ice area to the clear water and inversely. At the forcing of the ice the hull of the icebreaker undergoes heavy jolting and vibration. Especially solid must be the stem, the end points of the vessel, the shafts, the propellers, the rudder and the main engine. In particular the rudder shaft of the icebreaker must be 30% to 40% more solid than the rudder shaft of the ordinary vessel.

On the foremast of the vessels navigating in ice a "crow's nest" is installed as an observation post to observe the condition of the ice masses with one or several searchlights. The anchors and chains of a large size larger than ordinary, are placed on the icebreakers and vessels of Arctic navigation. The icebreakers are equipped also with automatic towing ~~maxmixk~~ winches. However, when towing in the ice conditions usually the automats are not used, since to regulate the tension of the cable in frequent and unavoidable jolting is very difficult, and in a majority of cases simply impossible. The steam engines of the deck mechanisms usually are disposed below the top deck, in order to protect them from freezing at subzero temperatures and icing when sailing in clear water in the winter season. The upper twin decks, as a rule, are used as living quarters and officers. Below the machines and boilers sections are installed together with bunkers, tanks, and others.

Especial attention is devoted at the planning and construction of icebreakers to the problems of avoiding the sinking. The anti-sinking security of the icebreaker must be effected by filling with water of two and sometimes three sections. This is achieved with water-proof condition of the main deck, by the increased number of transversal and longitudinal water pipe compartments, and also by the presence of the double-bottom along the entire hull and double sides disposed the full length of the engine - boilers or motor sections.

The icebreakers as a rule are equipped with autonomous water pumping systems.

Passing through the accumulation of hummocks and ice blocks frozen into a solid mass the icebreaker sometimes is so thoroughly wedged in, that it cannot get loose when giving a rear run with the machines. In such cases they build up artificially a list or trim by the transfusion of the ballast from one section into another. For this purpose special trim and listing tanks are installed in the hull of the ice-breaker. They ~~xx~~ are served with pumps of considerable capacity, which are capable to produce a list up to 15° in the course of two to five minutes, and a trim of 1.5 to 2.0 meters in the course of ten to fifteen minutes.

The ~~xtht~~ vibrations caused at list operations assist the icebreaker to get loose from the ice (Figure 38).

Figure 38. Operation of the list tanks on board an icebreaker.

Trimming of tanks can also be of great assistance at ridding the icebreaker from the ice when it is wedged in and stuck in the ice mass. At filling of the trimming tanks installed in the bow, the center of gravity of the icebreaker is shifted forward, and since at the same time the bow part of the icebreaker is raised above the ice mass, the center of size is shifted backward (Figure 39), with which a great rectifying momentum is produced.

Figure 39. The work of differential tanks on board an icebreaker.

The total weight of the water ballast installed on board the icebreaker, may come up as high as 15% of its normal water displacement. The listing and trimming of the icebreakers are resorted to also for life-saving purposes in case damage is done to the hull of the icebreaker along the water line or below it. In so doing the listing or trim is

built in such a way that the injured spot of the hull (with removed or weakened rivets and the breach) be above the water line so that the leakage may be stopped and measures taken for repair of the damage.

At first the listing of the vessel in Arctic navigation, naturally in its rugged form, corresponding to the level of technology of a time, was used way back in the Tenth Century. In the further trips over the surface of the Arctic Seas the Russian sailors were working out especial methods of steering the vessels, improve the foundations of the glacial tactics - the experience of navigation in ice and the struggle with the ice conditions. By using the wind assisting the course, in their sturdy wooden boats the sailors cut forcefully in the ice, and demolishing it, were sailing forward. If the ice did not yield, the crew shifted the cargo from the hold on the deck, thus reducing the stability of the ship, and then by moving from one side to the other, they balanced the vessel, and by cleaving the ice with the hull, cleared the course. The principle of rocking the boats in order to break them loose from the ice has been laid, in consequence, by the Russian designers as the foundation of the system of listing tanks of the icebreakers.

In 1889 during the construction of the icebreaker "No. 1", upon suggestion of the Russian shipbuilders the trimming system had been applied. In the bow section of the hull of the icebreaker a tank of 50-ton capacity had been installed. It was filled with water in those cases when the icebreaker upon its climb on the ice by its bow, could not break it down by its own weight. This was the first trimming system tank ever to be used on board of an icebreaker.

When navigating in the icy areas especial attention is devoted to Kingston valves. Since the grate of the ordinary Kingstons valves can be clogged up with broken ice grits and snow, the icebreakers are equipped by especial ice boxes. The ice boxes are the cases fixed to the paneling inside the hull of the vessel and communicating with the outside space of the grate. The entrance openings inside the ice boxes are placed as low as possible and are protected by additional grates. The pieces of ice or snow that find their

way into the ice boxes, emerge to the surface. In the ice boxes the pipes are introduced for the purpose of blowing through and warming of the ice. In some cases the transfer of water by the circulating pumps are used in order to clean the ice boxes.

However the ice boxes alone cannot fully protect the Kingston valves from ice and snow. Quite frequently when sailing in the crushed ice or in the ice grits the ice boxes had been filled completely, which made the icebreaker stop. In order to expedite the thawing of the ice in the ice boxes, quite frequently steam pipes are introduced in same. But this means is not sufficiently effective since in the case of crushed ice and sludge the ice boxes are filled with the outside ice faster than it is possible to thaw out the ice sticking in them. When the icebreaker is anchored the grates of the ice boxes are sometimes closed from the external side of the hull with reeds or floss, which would let through the water and detain the ice. Naturally, in the course of sailing such a method of protection of the ice boxes is inapplicable.

Each ship captain must be acquainted with the basic rules of the ship construction for navigating in ice areas, so that, in case of necessity, he may properly evaluate the projects of such vessels, and also supervise their construction. Moreover, only with a thorough familiarity with the installations of the vessel, solidity of its single parts, the ship captain can guide it in confidence, and carry out frequently most complicated maneuvers in the ice areas without damaging the ship.

The rules of construction and special reinforcements of the vessels destined for navigation in ice, have been set up through decades on the basis of the experience of their construction and operation in a set of varying ice conditions. These rules are not immobile. As the experience accumulates, and further studies of guiding the ships through ice have been made, as we know more about the damage caused by ice, and as we better evaluate the operations of the vessels in the process of their use, the rules are revised, changed and supplemented.

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In accordance with the rules of classification and construction of the steel vessels of the USSR tonnage register, the vessels for sailing in ice are divided into classes depending upon the area and ice conditions in which they are assigned to operate. The vessels provided with support and assigned to sail in broken ice in the seas of the southern areas of the USSR are provided with a class mark and addition of the letter "L" in front of its basic symbols, which means "pertaining to the ice areas", for instance

$$LR \frac{4}{S} S; \quad LR \frac{4}{1} S.$$

The vessels provided with special reinforcements for systematic navigation in the ice conditions and for work in the Arctic, are given the additional letters "UL" in front of the basic symbol and the mark "ARKT" or "LEDOK" following the basic symbols of the class, for example

$$ULR \frac{4}{1} S \text{ (ARKT)}; \quad ULR \frac{4}{1} S \text{ (LEDOK)}.$$

The freight-carrying vessels, towboats and other service vessels assigned to navigation in the crushed ice of the southern areas of the USSR, in accordance with the rules of the USSR Sea Register, must have special reinforcements. The special reinforcements of the hull must extend also to the vessels assigned for systematic navigation in the icy conditions (in the Arctic). As a rule, on board such vessels there should be not less than two decks while the lower deck is disposed somewhat lower, below the freight water line. For the vessels assigned for navigation in tow by icebreakers in the northern seas of the USSR, and for navigation in the Arctic regions in favorable periods of the year, the rules of the USSR Sea Register provide for additional reinforcements of the hull. The lower portion of the stem must have a rounded shape, while the area of its segment must not be less than 50% over the one prescribed in the special tables for ordinary ships. Besides this the stem must have a groove for laying of the sheets of the outside plating.

On the after stem of the vessels for navigating in the ice it is advisable to have an abutment for protection of the

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junction of the rudder rod with the rudder piece from the ice. The area of the segment of the after-stem must be increased not less than by 25% over the tabulated sizes. The construction of the locks of the stems in the area of the freight water line is not permitted.

On board the vessels operating in the ice conditions additional rows of beams with stringers are fixed, so that the distance between the rows of beams should nowhere exceed two meters. The beams are placed on every basic frame and are connected with knees. In doing so the beams are increased at least 25% over the beams installed for the deck of the forecastle. In each supplementary row of beams, stringers are placed by their width at least twice as wide as the stringers of the lower decks in the end sections of the ship. The stringers must be 15% heavier than the ordinary ones and with a corner along the edge in the bow and stern sections of the ship. In place of stringers it is advisable to set up platforms - continuous or with excisions. The stringers are attached with their ends not less than half the width of a stringer sheath. The fixing of the stringers with short corners on the wall of the profile is not permitted.

In the intervals between the rows of beams the hull stringers are installed of the same size as on the lower deck in the end parts of the vessel. These stringers are attached to the external plating, at a usual angle, while to the basic frames they are connected with knees. The stringers set up along the beams at the stem, are connected with a breach filler (perhaps breach piece). The floors by which the knees are connected are made one millimeter heavier than the floors laid in the holds. By the free edge of the floors the inverted corner pieces of the same size are fixed as in the engine room; besides this the rigidity corners are fixed. At the stern post /or stern peak/ of the vessels navigating in ice conditions, intermediate frames are also installed from the upper edge of the floors to the nearest deck disposed above the freight water line; the profile of the intermediate frames must be at least 50% of the profile of the basic frames.

To the frames disposed along the length of the hull of

the ship, between the bulkheads of the forepeak and the after in stern post, the rules of the USSR Sea Register prescribe also conditions of a greater safety. In particular, the inertia moment of the basic frames with the conditional girth must be not less than 75% over the one used for the usual set-up at a standard height of the skull knee. The knees for the single deck ships must be 25% over the one indicated in the special table for the standard vessels. The basic frames on the cheek knee have reinforced hardware corresponding to the profile of the frame.

Along the full length of the vessel the intermediate frames are installed covering up their height the ice girdle of the plating. In the bow and stern extremities at the legth of about 15% of the ship's length, figuring from the stem, the intermediate frames are installed, in case there is a double bottom, from the intermediate bottom sheath. In case the double bottom is absent the frames are stretched out from the upper edge of the floor to the nearest deck disposed above the summer freight water line. In the area of the chassis frames the inertia momentum of the intermediate frames is taken 30% and in the other places (along the length of the vessel) - not less than 20% of the inertia momentum of the basic reinforced frames. The removable installations in order to keep in equilibrium the rising lines are fixed to the basic frames from the U bars without holes in the shelf; the permanent attachments are welded to the frames.

In an area of at least 25% of the length of the vessel, figuring it from the stem, besides the basic and intermediate frames set up, as indicated above, also the chassis frames are installed with the side stringers. On 25% of the ship length, figuring from the stem to the bow and to the stern, in place of transition to the cylindrical portion of the hull it is advisable to install on single deck ships three or four chassis frames in the area of nine or ten stands with the correspondingly reinforced stringers. If these sections coincide with the base between the freight hatches, then the extreme chassis frames are installed along the ends of the hatches.

They install there also the chassis beams stretching along the full length of the vessel; the side stringers in

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this sector are reinforced. Along the full length of the ship the side stringers are installed which distribute the freight and secure the solidity of the frames at a distance of 1.75 to 2.00 meters. These stringers serve also as supports between the intermediate frames. Their position by their height is adjusted to the freight and ballast water line. The stringer sheathes must be 15% thicker than the profile of the basic frames.

Along the free edge of the stringers along the internal edges of the basic frames the ordinary angle bars are installed in shelves, at least 25% over the surface of the angle bars indicated in the special table of the Rules of the USSR Sea Register. The intercoastal (that is, consisting of several pieces) sheathes of stringers between the basic frames, which are used on ordinary vessels, on the ice navigating vessels should be made compact, while the intermediate frames can be welded to the stringers.

The solidity and rigidity of the deck set-up, and also of the comings of the freight hatches on the single deck vessels of the ice navigating vessels must be at least of the strength of the ones used on the ships assigned for shipment of the timber loads stowed on the deck.

When building vessels destined to navigate in the ice conditions especial attention should be devoted to the strengthening of the underdeck connections in the places of a sharp change of profile. In these places additional sheathes, brackets, etc., should be provided for.

On board the vessels with two and more decks, the lower decks in the front part of the vessels are being reinforced with a set-up 25% heavier than that required for the lower freight decks of the ordinary ships. One can resort also to another system of framing (by its rigidity and solidity on an equal level) between the fore and stern peaks. For instance, without the intermediate frames along the entire length of the ship; with reduced stands, for example, up to 400 mm; with the corresponding profile of the frames and others.

The local solidity of the hull of the icebreaker is

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secured by installation of additional hardware and with the shortening of the distance between the frames, which at the end points come down to 300 mm, while in the central part it is up to 400 - 450 mm.

At the same time also reinforced intermediate frames are being installed. The distance between the frames in the case of the icebreaker vessels usually is taken to be 600 - 800 mm. On the level of the ice girth the plating is 30 - 40 mm when planed out. Besides this, the local rigidity of the icebreaker hull and the icebreaker vessel is achieved by the set-up of the chassis frames, double bottoms, side stringers and ice girth.

At the water line level of the hull of the icebreakers the deck is placed (without its settling), and in the tests th the platform and the so-called ice beams are built in. The ribs of the transversal bulkheads usually are disposed horizontally, while the frames in the tips are built perpendicularly to the sides.

The relative solidity of various vessels, or a safe resistance to the pressure of the ice, fluctuates within wide limits from 16.0 to 200.0 T/M^2.

The port icebreakers are built usually with a single deck, while the auxiliary icebreakers are made with two decks, but the large heavy duty icebreakers - are built with three and even four decks. The engine room is disposed in the central part of the ship, in the area of the lateral coal holds. Then along the sides of the engine compartment a platform is set up. In order to keep it in position the semi-bulkheads or chassis frames are placed.

The external plating of the hull in a sector located 0.5 meter above the freight water lines, and by one meter below the ballast water line, along the full length of the vessel, with the exception of the bow and stern extremities, is made 15% heavier than the one indicated in the special table of the Rules of the USSR Sea Register for the side plating of the central portion of the ordinary ships.

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In the section of the ship hull equal to 15% of the length of the vessel, figuring from the stem, in the area of the above indicated height of the side the plating is made 20% thicker than the one required in the central part with a gradual passage to the stern and bow from the thickness of the ice girth to the thicknesses of the central part. The grooves of the plating in the area of the ice belt are riveted at least with two rows of rivets.

At the bow sector of the hull in case the rivets of the seams are following the tailored pattern by the edges of the sheets, wedge-like stripes are set, while the junction of the sheets of the ice belt plating are riveted on the inside junctions - on the planks.

Quite recently it has been recognized adroit to build the hulls of the icebreakers welded and not riveted, even though the corresponding special rules are not yet confirmed. The welded hull of the icebreaker has essential advantages over the riveted one:

1) at the same solidity the resistance of the ice is reduced;

2) there is no dnager of water penetration and reduction of the solidity of the hull because of rubbing, cutting or dropping out of the rivets;

3) the welded hull is considerably lighter than the riveted one, by which advantage the icebreaker can take in more fuel, water and increase its operational range;

4) the welded hull is considerably simpler in repair work than the riveted one.

The transversal water-tight bulkheads of the vessels of the ice navigation type have horizontal rigidity ribs. In addition to the fore and stern piece, it is permissible to set up horizontal rigidity ribs not along the entire width of the bulkheads, but on the extreme quarters from each side.

The diameter of the rudder rod on board the vessels navigating in ice conditions is increased at least by 25% over the ordinary ships. Accordingly, also the other elements of the rudder apparatus are increased. The pin of the rudder is cut in its upper part, in which case it is advisable to have the upper edge of the pin 300 to 500 mm below the summer freight water line.

The diameters of the dead wood (propelling) intermediate and crankshafts: in the case of vessels assigned for navigation in the ice areas, the diameters of these shafts should be at least 5% over those installed on board the ordinary ships; in the case of vessels of special icebreaker type, the diameter of the propeller shaft is increased by 7%, while those of the intermediate and crankshafts, not less than 5%.

On board the ships of Arctic navigation and propeller blades are made of steel, provided removable, and exerting high resistance and in possession of great viscosity. The relative solidity of the propellers and the shaft is so computed that they should not break at any contact with the ice.

"The rules for building steel ships of the internal USSR navigation"[1] for the river boats, which from time to time navigate in the crushed ice, only the ordinary reinforcement of the hull is prescribed. However, for the ships assigned for systematic navigation in the river ice conditions, - tugs, icebreakers and freight vessels, especial reinforcements of the hull are fixed, in each particular case in accordance with the USSR River Register. In doing so the reinforcement of the framing for the ships engaging in Arctic navigation, as determined by the Rules, is merely tentative. Changes can be introducedin same, setting out from the peculiarity of the construction and assignment of the vessel, the power capacity of the mechanisms and other conditions.

The river boats with the propeller engines must have their stems round underneath. The area of its transversal

<u>Footnote 1</u>: Moscow, "Rechizdat", 1952, Chap. XIV, pp. 38 - 40.

segment must be at least 50% larger than in the case of the ordinary ship. On the stem, they must have just like in the case of the seagoing vessels a groove for joining the sheets of the external plating and for protection of their edges from the ice damage. In place of the grooving also another method is admissible, for instance the box-like fixture made of sheet iron.

At the regular form of the stern the stern post is increased, by its surface section, at least by 15%; however, for the protection of the propeller and rudder of the ship when assigned for Arctic navigation, it is advisable to have them built with the cruiser-type stern.

The distances between the frames in the bow section in an area with the length of the stem, the full width of the vessel are between 400 and 450 mm, depending upon the class of the vessel. In place of such a diminution of the spans also the installation of the intermediate frames is permitted on an area from the top of the floor to the deck or to the hull stringer, but not lower than the upper edge of the ice belt.

The framing in the area of the fore post is usually attached to the plating, especially in the vessels possessed of full formation. The hull frame in the front end of the vessel including the forepeak on the sector extending from the stem for about the width of the vessel is reinforced at least by 50% as over against the usual frame required by the USSR River Register. Along the remaining length of the ship, including the stern piece, this reinforcement should not be less than 25% and is usually achieved by the increase of the dimensions of the frame or by the reduction of the spans to 400 - 450 mm, according to the class of the vessel. Also the installation of the hull stringers and chassis frames as well as other methods of reinforcement of the hull frame, are permitted.

Along the full length of the vessel assigned for navigation in the Arctic the ice belt of the external plating is installed 250 mm above the freight water line and 400 mm above the light water line, with allowance for the possible

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trim of the vessel. The ice belt in the area of the forepeak and in the sector equal to the width of the ship behind the forepeak, is 40% thicker, and in the area of the stern piece it is 25% and in the remaining tract of the vessel by 15% thicker than the hull plating in the center of the vessel.

For distribution of the ice pressure and stability of the hull frame along the entire length of the ship, roughly in the center of the height of the ice belt, a hull stringer is fixed.

Especially attention is devoted in the construction of the vessels of the internal ice sailing, to the stability of the profile of the frame in the extreme ends of the vessels, where frequently additional stringers are fixed. In the end points of the vessel the house stringers are well connected with the breach junctions, in the same style as on board the seagoing ships.

The transversal bulkheads of the forepeak and stern peak are built with the horizontal rigidity ribs. The horizontal rigidity ribs are installed on the bulkheads limiting the engine - boiler room in a section equal to one-fourth of their width, from each side.

The diameter of the rudder rod and consequently the other elements of the rudder operation on the vessels with the mechanical rudder movement is increased by 10 to 20%, depending upon the class of the vessel.

The diameter of the dead wood and intermediate propeller shaft is increased by 5 - 10%. The propeller screws are usually provided with dismountable steel blades, as well as in the case of the seagoing vessels. Furthermore the solidity of the screws is calculated with reference to the solidity of the shaft in such a way that whenever strik ng against the ice, the screws should break, and not the shaft.

Into the vessels of the internal Arctic navigation the same requirements are attached as to the power driven ships with screw engines. The only exception is the thickness of the ice belt in the area of the stern peak; in the case of

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vessels that are not power driven, the thickening of the sheets should not be over 15%.

Section 10. The Recent Achievements in the Field of Icebreaker Construction.

From 1954 on, in the USSR new wholly welded Diesel electrical icebreakers have been introduced into operation, being provided with four propeller screws. Likewise the freight shipping icebreaker vessels are introduced. By their icebreaking properties these have considerably exceeded all ships of this type that have ever been constructed. The first of these icebreakers - "CAPITAN BELOUSOV" (Figure 40) has been launched on the 15th of December, 1953. Its greatest length is 83.16 meters, width 19.40 meters, and the height of the hull to the upper deck 9.50 meters. The medium greatest draft 7.0 meters, water displacement 5,360 tons, capacity of the propeller screws 10,500 hp.

Thus on one ton of water displacement of the icebreaker "CAPITAN BELOUSOV" 1.96 hp applies, at the same time as in the case of icebreaker "I. STALIN", when utilizing the full capacity of the machines. This correlation was not over 0.90, while in the case of the icebreakers "KRASIN" and "ERMAK", - it was about 1.0.

The new icebreaker has two stern and two bow screws. Up to now among the shipbuilders and the navigating crews, there was no uniform view in the matter of building an icebreaker with two front screws. One of them argued that such an icebreaker even in the thin ice areas will soon be brought out of commission. Others, on the contrary, deemed that it can operate effectively in all the freezing basins of the USSR, but only in the thin and weak ice areas.

However, as the experience of operation of the ice-

breaker "KAPITAN BELOUSOV" demonstrated - one of the first icebreakers with two nose propellers - in the ice areas of the Finnish and Riga Bays, the bow screws splash effectively both cheeks of the icebreaker. In connection with this the pressure of the ice masses against the hull is considerably reduced, while the breaking up of the ice is rendered easier. Besides this the disposition of the propeller screws applied on an icebreaker is increasing its maneuverability.

The prime capacity of the propeller installation is produced by six Diesels, each of which is directly connected with the corresponding generator of the electric current. These generators feed four rowing electro motors. The steering with the engines is done directly from the bridge, without the participation of the engine crew.

The advantages of such automatization are obvious:

1) the change of speed and direction of the course is achieved much faster;

2) the accuracy of the needed course and the sailing speed are guaranteed; in the practice of the Arctic navigation, especially at ice chipping around the vessel, during the mooring operations, frequently the wrong course is given (for instance, instead of "full course backward" - "full course forward"), which caused serious damage. However on the ice-breaker "KAPITAN BOLOUSOV", the machine telegraph is installed on the commander's bridge, the captain sees the situation and cannot make any mistake.

The engines of the icebreaker "KAPITAL BOLOUSOV " are rotating always in one direction, developing the full capacity of power independently from the revolutions of the propelling motors. As we know, the ship engines are most frequently worn as a result of frequent changes of sailing speeds and direction of the course. On board the icebreakers during the towing procedure of the ship in the ice and especially at the time of ice chipping and mooring the number of reverse movements is usually considerably greater than on board any other ship, and for this reason the motors are worn more rapidly. On the other hand the continuous rotation of the motors in

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one and the same direction increases considerably their life-time operations.

The icebreaker "KAPITAN BELOUSOV" has two continuous decks, a prolonged forecastle and a large superstructure on the upper deck in the central part of the vessel (Figure 41). The double bottom passes along the entire hull from the bow to the stern. Under the main deck the ship is divided into water-tight sections by transversal bulkheads, separating four engine rooms and two freight holds. Two continuous longitudinal bulkheads along the sides of the ship form eight pairs of side tanks.

Under the double bottom and in the lateral tanks, in the fore and stern peaks 1,025 tons of diesel and boiler fuel is stored, 80 tons of lubricating oils, 163 tons of fresh water, 75 tons of cooling and 368 tons of ballast water. Such supplies secure the autonomous nature of the navigation of the icebreaker roughly for a period of 56 days. One should consider that the autonomous nature of the icebreaker sailing, operating on solid fuel is not over ten to twelve days, which considerably reduces the effectiveness of their operation, so that frequently over 30% of the operational time is spent on replenishing of the fuel supply, and on the road to the bunker base and return.

Between the main and upper deck in the central part of the icebreaker "KAPITAN BELOUSOV" two listing tanks are disposed. Powerful pumps make it possible to pump over from one list tank into another 160 tons of water within 90 seconds, and build up the list for freeing the icebreaker when it is wedged into the ice mass. Up to this time such an operation on board the icebreakers was carried out in a period of from three to five minutes.

The relation of the length of the hull to the width in the case of the icebreaker of the "KAPITAN BELOUSOV" type is 4.2, which differs but slightly from the existing icebreakers ("JOSEPH STALIN" and "KRASIN" - 4.6, "ERMAK" - 4.5, "MIKULA SELYANINOVICH" - 5.0 and "DOBRYNYA NIKITICH" - 4.2).

The incline of the stem of the icebreaker "KAPITAN

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BELOUSOV" forms 23°, as in the case of many other icebreakers of an earlier construction ("I. STALIN" and "ERMAK" - 25°, "KRASIN" - 24°). The same can be said also of the incline of the hull side. In the central part of the hull the side of the icebreaker "KAPITAN BELOUSOV" in the area of the water line forms an angle of 20° in relation to the vertical, which protects the vessel from being pressed by the ice masses. In the case of the icebreaker "I. STALIN" this angle is 21°, in the "KRASIN" and "ERMAK" - 22.5°.

Figure 40. The icebreaker "KAPITAN BELOUSOV"; general view.

Figure 41. The icebreaker "KAPITAN BELOUSOV"; diagram.

The thickness of the external plating of the hull of the icebreaker "KAPITAN BELOUSOV" is 30 mm in the area of the waterline, thus coming near the icebreakers which were built in the past ("JOSEF STALIN" - 1x35 mm, "KRASIN" - 32.3 mm, "ERMAK" - 27 mm, "LENIN" - 28.5 mm). The frames of the icebreaker "KAPITAN BELOUSOV" are made of the angular steel 250 x 90 x 14 mm. The spaces in the central part of the ship come up to 400 mm, while in the bow and in the stern they come up to 350 mm (on board the icebreakers "JOSEF STALIN", "KRASIN" and "ERMAK" - 610 mm in the case of the intermediate frames).

The height of the inter-bottom space on board the icebreaker "KAPITAN BELOUSOV" is 1.8 meters ("JOSEF STALIN" - 1.22 - 1.54, "ERMAK" -- 1.07, "LENIN" - 1.26 meters). The increased height of the beam of the bottom cover increases considerably the solidity of the underwater part of the hull of the new icebreaker.

The sides of the icebreaker "KAPITAN BELOUSOV" are reinforced with four horizontal stringers, two of which pass straight from the bow to the stern. In addition, on the full length of the tract from the bow to the stern to the hull a large number of chassis frames are installed. The stems, the

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sockets of the propeller shaft and the rudder of the new icebreaker are cast from steel. The diameter of the rudder rod is 400 mm; the stern of the vessel forms in its upper part a cut-out - a towing depression, provided with fenders made of steel cables.

The icebreaker has four engine rooms. In the central part of the ship two equal diesel rooms are located, and toward the bow and toward the stern each, there is one section of the propeller engines. On the main deck under the diesel sectors the energetic post is set up for the control and direction of the electromotors. Above the energetic post on the upper deck the boiler section is disposed. The diesel sectors are entirely independent from each other. If for some reason one of them goes out of commission, the others will keep operating undisturbed. In each of the diesel sections three main and two auxiliary diesel engines are installed, ~~rotating their own generator~~.

The main diesels - eight cylinders, nonreversive, of simple action, have two strokes. Each motor develops normally by prolonged operation the capacity of 1625 electric hp, at 325 RPM. When forced it can be overloaded for six hours up to 2000 hp at 100 RPM. This property is especially valuable when operating in heavy ice areas where the forcing of ice is quite frequent.

The main generators - are of direct current, double anchor type, have their own independent excitation; they are calculated for a steady capacity of 1370 kw, at a tension of 400 volts and 400 rpm.

The auxiliary diesels - are six cylinder, double-stroke engines. Each auxiliary diesel cylinder can develop 300 hp at 550 rpm and is connected directly with direct current generators at 200 kw.

The presence of six main diesel engine generators operating four-propeller motors makes it possible to combine the subconnection. The main switches are so distributed that for each motor there are three, and that for each propeller engine there are three, and for each main generator - there are two switches.

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With such a system one can connect two different generators with each motor. Due to this there is a convenience to distribute on a different scale the maximum power (for instance to have two-thirds of it operate the stern propellers, and one-third of the power to operate the bow propellers, or inversely). In addition to this, in case of necessity, for example for the purpose of surveying, one can fully disconnect two motors, and each propeller motor will get its feed only from one generator.

The boiler installation of the ship consists of two steam boilers of the Scottish type with two atmosphere pressure and the surface of heat at 45 m². The boilers are heated automatically with mazut. In all the machine divisions, freight holds and fuel tanks the oxygenic extinguishing is installed, while in the diesel sections, in addition to that, we have the foam extinguishing, while in the exhaust tubes there is steam extinguishing.

Four complete four-blade propeller screws of the icebreaker are cast from steel. The bow propeller screws are especially solid, having 3.5 meters in diameter, and weight 8,360 kg. The stern propeller screws have a diameter of 4.2 meters and weight 9,800 kg each. The reserve screws are provided with separate blades. The diameter of the propeller shaft is 400 mm.

The icebreaker "KAPITAN BELOUSOV" is equipped with an electrohydraulic rudder engine. The anchor apparatus is provided with the electrical drive and is executed in the form of spires with asterisks and turrets brought out on the deck of the forecastle. The power drive mechanism is disposed below on the main deck. The automatic tow winch, installed in the stern part of the upper deck is provided with two drums which are calculated to pick up towing loads of 30 and 60 tons. On board the icebreaker built in the past (with the exception of the icebreaker "SIBIRYAKOV") the towing winches are usually supplied with one drum, and that of considerably lesser capacity. Thus the towing strength of the tow winch of the icebreaker "JOSEF STALIN" is 25 tons, and of the icebreakers "KRASIN", "ERMAK" and "LENIN" - 10 tons. On the deck of the forecastle two 3-ton load lifting winches are installed.

The ~~mmmg~~ controlling of the diesel electrical devices of the icebreaker is possible from two bridges, from the rudder cabin, from two places on the upper bridge and from one controlling post in the stern end of the Captain's deck. The operations carried on from the rudder cabin and from the top bridge are effected with the aid of the maneuvering columns with the mechanical transmission into the maneuvering section. The control from the stern end of the captain's deck is effected with the aid of the electrical engine telegraph, connected with the maneuvering section. In addition, there is an electro engine telegraph on board the icebreaker, in the capacity of reserve device, which is located in the rudder booth.

The steering posts operated on board the icebreaker are equipped with the indices of the number of revolutions and the direction of rotation of the propeller screws. The steering post on the stern end of the captain's deck has, in addition, a steering telegraph for transmission of the command in the rudder booth.

The icebreaker is provided with all the latest electro-navigational instruments and with four searchlights.

The ventilation of the living quarters is effected by the mechanical pumping of the fresh air, whose temperature can be regulated.

In addition, for the end cabooses, cabinets and officers' ward, as well as in the sanitary premises on board the icebreaker, there is a mechanical exhaust ventilation. The living quarters of the icebreaker are equipped with hot water heat, while the other premises are heated by steam.

On board the icebreaker there are four lifeboats for 60 men each, further an ice barge and two motor launches.

Besides the icebreaker "KAPITAN BELOUSOV", in March 1954 an icebreaker-freight-shipping vessel arrived in the port of Murmansk. This ship had been built by the project of Soviet engineers and provided with diesel electrical installations. At the present time two more such vessels are in operation in our Fatherland. These vessels are built for the class of

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USSR Sea Register "ARKT" (Figure 52). They are equipped with all the latest electro-navigational instruments. The normal full load-carrying capacity of a diesel electro-ship 6,500 tons, while the maximum is - 7,560 tons; the maximum freight capacity with full supplies is 6,160 tons, while the normal figure is 5,100 tons. The full registered displacement of the ship is 7,503.29 registered tons; clear - 4,250.74 registered tons; at the normal water displacement for one cm of draft, 18.5 tons of load is figured.

Figure 52. Diesel electric icebreaker.

The maximum length of the vessel is 130.19 meters; the length of the freight water line at 7.5 meter draft is 121.7 meters, the width of the load water line - is 18.5 meters. The maximum draft of the vessel is 8.15 meters, while at the full freight capacity of 6500 tons - it is 7.52 meters.

The vessel has three decks, four holds with twin decks and two additional twin decks under the deep tanks and the fuel. The height between decks is quite sufficient for disposition of the proper general loads. The cubage of the freight-containing premises is 9.914 m³, ~~whilexthexxxf~~ and, in this number of the freight holds between decks, 8,980 m³, while that of the deep tank 934 m³. The specific cubage with the general freight is 1.95 m³/ton, while with the liquid load in the deep tank it is 2.16 m³/ton.

The loading and unloading of the vessel is effected by means of six freight-receiving hatches with ten freight arrows of five-ton lifting capacity, two heavy arrows with lifting capacity of 50-tons each, and with 12 electrical winches of five-ton lifting capacity each.

The load-lifting booms are supported by two mizzen-masts and two pairs of columns. The moving range of the load-lifting booms outside the hull side is four meters, while that of the heavy duty booms is six meters. On the middle and lower decks the small grain-pouring hatches are added in case of shipments of sandy or loose loads.

The icebreaker - freight shipping Diesel electric vessel is distinguished by excellent seagoing properties. The metacentric height of same comes up to 0.19 meter when free of load, under the normal load it is 0.68 meter and at the maximum load - 0.75 and in the ballast 1.14 meters.

One should assign to the number of positive properties of the vessel while sailing in the icy areas, also its excellent stability while running on its course. Thus, in the case of the icebreaker "SEVERNYY POLYUS" the angle of lerch while operating in the icy areas came up to 90°, in the case of large steam driven icebreakers it comes up to 60°, while the new Diesel electrical icebreaking vessels have a mere 8 - 12°. The excellent stability of the vessel can be observed also at the towing of two ships on a short cable, while in the stern excision when towing one ship. At the backward run the vessel cannot be steered, which can be explained chiefly by the larger value of the relation of the length of the vessel to its width (6.5).

When navigating in free water at the wind force of nine balls and waving at eight balls, one should observe a smooth hardly noticeable rolling in the periods of 15 seconds. The vessel refuses to take any water on its deck during the storms, while the splashes from the waves smashing against the hull, do not come up to the commander's bridge.

The framing of the vessel is of the longitudinal transversal system with the solid basic and intermediate frames; in the bow parts of the hull - the chassis frame is disposed within spans of 400 mm; the basic and intermediate frames are of equal size: 300 x 15.2 mm. The outside plating in the area of the ice belt is 20 mm thick, in the bow part its thickness is 30 mm, in the stern part 25 mm, while in the area of the shear streak - 15 mm and at the bottom - 19.5 mm. The horizontal keel is made of steel 19.5 mm thick, the upper deck is 14.5 mm, the lower deck - the stringer - 25 mm thick.

The security from sinking is provided by eight main transversal bulkheads at the normal draft in case of flooding of two sections, and at the maximum draft - of one section.

When sailing in the ice the impacts of the propeller screw against the ice have been observed very rarely, and a full wedging in of the screws have not been observed at all. This is explained by the great deepening and excellent protection of the screw.

Due to the shape and various angles of the incline of the stem (in the operating part 30°, and in the lower part 70°) the ship cannot rise on the top of the ice higher than one meter during its sailing in ballast and at the same time does not let through the ice block under the bottom, but brings them to the sides. When navigating in solid crushed ice areas the single ice blocks at their impact against the stem are not crushed, but are pushed ahead and follow along the incline of the stem to its lower part. Here the ice block, at its impact, is broken up and the pieces of ice emerge along both sides in the area of the hold No. 2.

If a very solid ice block fails to crumble at its impact against the stem, then, leaning against the low part of the stem, it changes its direction with reference to the hull of the vessel, comes out to the inclining part of the side and emerges to the surface, moving along the side. For this reason the pieces of ice do not get under the screw very often. In operations in fairly difficult conditions only three or four impacts of the ice blocks were observed against the screws, which had for its result decreasing of the revolutions, however there was a case on record where the screws have been wedged in.

Among the essential defects of the broken up form of the stem we find the noticeable reduction in the passage of ice masses, that is, deterioration of the basic and main property of the vessel. Besides this the sudden change of the incline of the stem from 30 to 70° while the vessel deploys at high speed, results in a sharp impact of the stem against the ice, which causes the vibration of the masts and superstructures. Obviously on such vessels in the subsequent construction of same the stem must be made in the customary unbroken line.

The incline of the sides of the Diesel electro-boats comes up to 8°, which, as the experience in the operation of

the vessels of this type have demonstrated, fully justifies itself. So when sailing in heavy ice masses the Diesel electric vessel got into a position of powerful compression. In spite of its heavy weight the vessel was pressed out almost a full meter, however, the hull did not suffer any damage.

The shape of the stern of the ship is that of the cruiser type with the protective onflow and ~~fxx~~ stern incision for the towing at a short distance. The onflow protects successfully the screw from ice injuries while backing, and the stern excision not only makes it possible to tow the other vessels at short distance, but also to operate pairwise with another vessel by the "tandem" method.

The plating of the ice belt is made of steel with the object in mind to load it up through ice pressure by 50 - 60 kg per cm^2, while its bottom, decks and frame by 41 - 49 kg per cm^2. The framing and frames of the icebreaker vessels are also made of steel of a better quality. This secures the high solidity of the hull while the weight of the vessel will bex considerably reduced, and thus its useful load volume will be increased.

Thus, the solidity of the new Diesel electric boat answers all the requirements which can be applied to a vessel, which sails in the ice on its own. In the process of navigation in the heavy Arctic ice masses it was not exposed to any ice damage, since its solidity corresponded to the requirements of safe navigation in the summer Arctic ice areas with top speeds of 10 - 12 knots.

A steel ice propeller with removable blades, and a 4.6 meter diameter is installed on board the ship (the same size as that installed on board the icebreaker "KRASIN"). The turn of the screw is 2.65 meters. The pressure of the propeller screw with reference to mooring - is 71 tons and at three knot speed - 65.2 tons. At the standard draft of the ship the protective layer of the water above the screw is 2.5 meters and in the ballast - 1.5 meters. The rudder is of the frame construction with filling, diameter of the rudder rod being 345 mm; there are two electrohydraulic rudder operating engines with a hydraulic tele-motor of 30 hp, each.

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The time of the rudder shift with the aid of the steering machine, from one side to the other is not over 20 seconds, and on 15° with the aid of manual operation - 6 minutes.

The mechanical installations of the vessel are of the Diesel electrical type, with a power capacity of 5200 hp. The propeller installation demonstrated its solidity under all conditions of work in the ice. The speed of the navigation course is regulated automatically. The engines pass easily from the regimen of the ice navigation to the sailing conditions in the free water.

The two-contour design, which is used on the ship, makes it possible to obtain a great efficiency (87.7). Besides this, if one generator goes out of commission, one may keep sailing without cutting the movement with the energy of the second generator.

Even in the case the screw gets wedged in the ice, which as a matter of fact is very rare occurrence in this case, immediately after its release the screw automatically begins to rotate normally.

The best utilization of the capacity of the engine installation is secured while navigating in free water. The steering of the propeller installation is simple, convenient and reliable; it is effected from the open and covered bridges. The steering posts on the upper and lower bridges are connected into one scheme. If the telegraph on the lower bridge is not set to zero position, then steering from the upper bridge is impossible. Developing up to 360 rpm, the Diesels do not have a prohibition zone, and practically there is no number of revolutions at which on board many vessels powerful vibrations of the hull would start, involving that of the superstructures and spars (masts). On board the new ship the vibration does not reach the unpermissible limits under any circumstances or conditions.

In the ice conditions the Diesel electrical installation has excellent properties. The basic ones consist in the following: the motors being nonreversible, have great motor resources (up to 30 thousands per hour), make possible the division of the power and the great overloading momentum;

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operating the motors is made safe directly from the bridge, which makes it possible to effect any change of speed or direction of the course in a period of 12 - 14 seconds.

The navigation range of the vessel at full capacity, developed by the motor installation with normal supplies, is 10,900 miles, and with a maximum supply, - 15,600 miles. The consumption of the fuel per day is - for development of Diesel power - 35.5 tons, of the boiler run 4.8 tons; the specific consumption of fuel is 173 gram/hp, per hour.

The new freight-carrying icebreaker vessels can overcome such ice masses which no icebreaker of former construction, could overcome.

The specified data about permissible sailing speeds of the new vessels depends upon the ball values of the ice.

In the broken up Arctic ice, weakened in summer at any ball class, at the maximum thickness of 1.8 meters and the area of the surface of about 700 m^2, the top permissible speed of the vessel is 10 knots.

In the broken-up ice fields of any ball value and size at the maximum thickness of 0.7 meter, in the most solid fresh-water ice masses, and also in the fall and spring ice of the Arctic, in the broken-up ice masses of any ball value and size, which have been weakened by thawing, at the maximum thickness of 0.9 - 1.0 meter, and in the broken Arctic ice masses of any ball value at the maximum thickness of 1.9 meters (after installation of auxiliary instruments weighing 26 tons) the top permissible speed of the vessel is 15 knots.

The time of forcing heavy ice masses is about ten minutes, including the backward run of 2 - 4 minutes, deployment of the vessel in the channel for the impact - 2 minutes and movement in the solid ice 5 - 6 minutes. As a rule the forcing of a heavy ice dam is effected by two or three onrushes.

Usually the speed of the vessel at the moment of impact is three to five knots, although in exceptional cases impacts were resorted to with the speed of eight knots and more.

There is a record of several cases of ice forcing at the speed of 14 to 15 knots. If the stem of the vessel strikes that place where the edges in the adjacent areas of the ice are slightly weakened, then immediately after the impact the xxxxx stem rises 50 - 60 cm on the top of the ice cover. Then the ice will form far-reaching cracks, perpendicular to the outline of the hull and break into large pieces, which at further sailing of the ship stand up ribwise, and partially are sunk.

Further, in the area of the six to eight theoretical frames the separate ice masses are crumbling into smaller pieces. If the impact is leveled at a weakened sector of the ice field, into the snow mass or hole, the stem almost refuses to rise. In this case large cracks are formed in the direction of the hole (or nearest hole) and the ship after the impact will achieve greater speed than in the first place.

When forcing the separate ice dams or massive hummocks of pressure ridges the ship experiences powerful jolts, obviously because of the protrusion of the stem. After the jolt a brief vibration of the superstructures and the masts is observed, and in particular cases also the vertical vibration of the stern.

At the ice thickness of about 1.5 meters and the snow cover of about 10 cm thick, at underwater ridges of the hummocks and the hummocks with above the surface ridges, the ice masses stand up rib-wise at the sides of the vessel and in the sector of about the middle of the hull of the vessel they are broken into small pieces.

The capacity of the ballast tanks with the deep tank of the Arctic Diesel electric vessels is 2,526.2 tons. Considering the high speed and the capacity of the vessel to break through the ice, such supplies of fuel are required only in the xxxx unusual operational sailing. However, in the ordinary conditions they are not called for by the necessity and without injury they could be somewhat reduced. In place of that one could increase the freight capacity of the ship.

The anchor installation of the icebreaking Diesel

electric boat consists of two electrical spires at 52 hp each, of two Hall anchors weighing 3,760 kg, of a chain 22 275 meters long, 57 mm caliber, the wedging and chain stops. The speed of the anchor hoisting is not less than 12 m/min. The anchors are stored away in the nitches of the hull sides. There are four life-boats on board the ship, a launch, working barges with motors of 15 hp.

The ship is equipped with the electrical towing winches with the tow strength of 25 tons, the towing cables being 152 and 127 mm thick, and 220 meters long each. In addition to this there is one towing bit with a horizontal pedestal, the Sullivan stopper of 60 ton capacity and the closed hawse hole of the stern.

The firing extinguishing apparatus consists of the water and carbonic acid apparatus for putting out the fire, and also of the smoke indicating signal of the "Saval" system. The ship is equipped with two pumps with a capacity of 100 m^3/hr with a pressure of 60 meters. The ballast and drawing systems consist of two pumps of 100 m^3/hr capacity. Besides this there is an electrical pump with a 20 meter pressure. The water draining system consists of four pumps of 300 ton/hr capacity and two portable electrical pumps with a capacity of 240 m^3/hr. These pumps are installed on slide rails and can be unloaded by the load boom on the ice for supplying of the fresh water from the snow thaw.

In order to deliver drinking and washing water there are three pumps aboard the ship with a capacity of 5 m^3/hr with the electro motors of 2 hp each.

The sanitary system is attended to by two pumps with a capacity of 15 m^3/hr with an electromotor of 7.5 hp capacity.

The heating system aboard consists of both of the steam heat and hot air type. It keeps up the temperature at the level of + 17° C while the outside air is 33° C below zero.

The differential system is not available on board the ship and, as the experience has demonstrated, it is not even necessary.

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To the number of deficiencies of the new Diesel electrical vessels assigned for navigation in the Arctic waters can be assigned the relatively small dimensions of the load-carrying hatches and the insufficient speed of the load-lifting winches. The upper deck of the vessel is not usable for storing of the deck freight and especially of the heavy loads, since its major part is occupied by the pipes and ventilators. The ship is not adjusted for the shipment of loose loads and especially of apatites, cement, fine coal, etc. When loading and unloadings them, the rising dust penetrates the ventilation system which adversely affects the motors, the Diesels, official and living quarters. The reserve side bunkers are connected with each other directly; owing to this, at heavy rolling the fuel is poured over from one side to the other, and is even thrown out on the upper deck.

Finally, there is no operational necessity of having such a great deep tank as is installed on a Diesel electrical ship, since the liquid load is usually shipped in large tankers. By the removal of the deep tank, from our point of view, it would be advisable to increase the freight-carrying capacity of the vessel for the shipment of dry loads.

The construction and operation of a four-screw ice-breaker and the freight-carrying Diesel electric vessel made for navigation in the Arctic waters, is a new long step forward in the field of combating the ice, increasing the navigational period in the polar seas and will secure the possibility of the full year sailing in the other freezing water masses. Further build-up of the icebreaker fleet with such vessels will make it possible to considerably increase the volume of shipment in the winter periods in all the freezing basins.

In addition to that, the construction and operation of the Diesel electric icebreaking vessels will make it possible to dispense at any ice setting without being towed by the ice-breakers just by passing to the autonomous navigation in the ice areas at higher speeds. Powerful heavy duty icebreakers can be used only for patroling in especially difficult sectors. Thus the cost of the transportation will be considerably reduced by reduction of the expenses for the upkeep of the icebreakers.

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CHAPTER III

ORGANIZATION OF ICE NAVIGATION

Section 11. The Crew of a Vessel Assigned for Navigation in Ice-Covered Regions.

One of the main conditions of a successful navigation in the ice regions for the vessel of any category is the high qualification of the crew, the steady and strict execution of the navigation rules governing navigation in ice areas, rules that have been worked out through experience of many years. The navigation in the icy conditions, especially in the winter season is complicated and difficult task. Quite frequently after the change from the watch at the rudder the sailors are not given a chance to rest up - they have to occupy their places on the bridge, on the forecastle, or on the top of a mast (crow's nest) in order to follow the ice conditions. Even in the normal conditions when navigating in the ice areas it is necessary to measure every hour the water level in the water channels. While forcing the ice cover or as one proceeds through a tortuous channel, the water level in the containers along the keel must be determined the most frequently possible. It is necessary to follow relentlessly the sailing speed, and while navigating in the coastal areas one must measure the depth.

If the vessel is being towed by an icebreaker or is towing another ship, the deck crew and sometimes even the machine crew must operate with heavy towing cords (cables) and trecks.

The conditions of sailing in the ice require a frequent transmission of signals, which is attended with additional work of the sailors. One has to work intensely also in the engine room by its crew. When sailing in the ice frequently and sometimes even unceasingly, the speed and the direction of the course is changed. Each error of the engineer or mechanic may become responsible for serious damage, while

carrying out the orders passed on from the bridge. In coordination with the service rules effective on the vessels of the seagoing fleet when passing through the narrow and dangerous places, when the running speed must be frequently changed, the captain of the ship must be on the bridge and the chief engineer at the engines. When navigating in the icy regions such conditions emerge frequently for a continuous period of time.

On board the steam vessels the firemen work with great intensity. Frequently the stops in the sailing course due to wedging in the heavy ice masses require the steam to be blown off, and after the chipping-off of the ice by the ice-breaker, the engine must be given its full course, that is, within a relatively short period of time one must create steam pressure in the boilers, which is connected with considerable difficulties.

In view of the very complicated conditions of work the crew for the service in the Arctic navigation is usually selected from the number of the strongest, hearty and experienced sailors. Before setting out for a sailing cruise the members of the crew are passing before a special medical committee.

The Soviet sailors who are performing the difficult work in the endless ice fields of the northern and Arctic seas, are surrounded with the daily care of the party and government. Warm and comfortable fur garments and footwear is given to the crews of the vessels for the winter. As a matter of first urgency the personnel is provided with artistic and technical literature, with table games, musical instruments. For the sailors working in the ice conditions, special radio broadcasts are arranged, frequently upon their own request. The political administration of the Ministry of the Maritime Fleet usually passes on to the ships radio bulletins, from which the sailors find out the latest news of the internal and international life.

The steamship companies and organs of supplies are providing the vessels of Arctic navigation with the high-class fuel and lubricants, with necessary materials, instruments and spare parts, which makes it possible for the crews

to maintain the ships in good technical condition, often in quite complicated conditions.

Section 12. The Preparation of the Fleet for the Fall - Winter Navigation.

Each year, usually in September, the Minister of the Seagoing Fleet issues an order for preparation of the ships, undertakings and organizations for work in the Fall - Winter conditions. Alongside with other measures taken in this order, as a rule, the directors of the steamship agencies, the ports and basins of the directing offices of the trip, are required to work out on the basis of a deep analysis of the fall - winter campaign of the foregoing year, increased measures dealing with the preparation and securing of the normal and uninterrupted work in the course of the winter of the current year.

The vessels adapted for work in the ice conditions are removed from the complement of the acting fleet, in accordance with their technical characteristics. For the proper utilization of the fleet in the winter period the ships are quite frequently shifted from one station to another.

In the areas with different ice conditions the ships are sent with the corresponding Arctic categories. The weak ships with low powered engines with light or worn hulls, are kept to operate in the non-freezing areas. The use for Arctic navigation of the worn or lightly constructed ships may cause considerable delays in the towing of the caravans, the loss of time by the icebreakers, and even serious injuries and finally, loss of the ships themselves.

Thus in the Bay of Finland the steamer "SUDRABU EKZHAS" was lost; the weak worn hull of the vessel suffered serious damage while following in tow an icebreaker. The vessel sank so fast that the crew hardly could descend on the ice, while the heavy duty icebreaker with powerful water pumps, even

though being in line with the capsizing ship, could not give the victim the necessary aid.

From year to year the steamship agencies check in fall the vessels and prepare them for operation in the winter conditions. They provide each ship with perishable provisions, with the radio navigational and piloting instruments, with an abundant supply of provisions, etc.

The Ministry of the Seagoing Fleet, depending upon the tasks set up for the fall - winter navigation, distributes all the icebreakers, icebreaking tugs, the towing and rescuing ships capable of operations in the ice conditions, while the chiefs of the ports and directors of the steamship agencies make them ready for operations, allot them their order of sequence and provide them with all necessities.

The lists of vessels selected for operations in the ice conditions are coordinated with the inspections of the USSR Maritime Register. In proper time, usually before the first of November, the technical conditions of these vessels are checked: the reliability of the hatch covers, the water-tightness of the illuminators and bottlenecks, the flawless condition of the water-draining devices and the system of the fuel heating, and sometimes even that of the water, the electric navigational instruments and searchlights, completeness and preparedness for action of the life-saving and fire-combatting means.

Exact dates are determined and good men are assigned who will be responsible for the full preparation of each vessel for normal and undisturbed work in the course of the winter navigation, and also are organizing a strict supervision for the execution of measures to be taken at proper dates.

A thorough checkup is made to see whether the vessels are provided with the corrected charts and sailing directions, they give a thorough and minute instructions to the captains and their staff, especially those who are sent for the first time to responsible ice navigation trips. Still in proper time the personnel of the vessels is checked over, the ones that are selected to work throughout the winter period, are subjected to medical inspection, and build the necessary

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reserve for replacement of those members of the crew who had to be discharged. At the same time they carry out the measures for heating of the ships' systems, living quarters and passenger premises on board the ships.

A very careful watch is established to prognosticate the weather and the ice conditions in the freezing ports and areas for the timely removal of the vessels. The operational work was carried out in accordance with the weather forecast, the synoptical and hydrological situation, carefully following also the local weather conditions.

In the ports which are not selected to maintain the navigation following the ice formation, before its closing all the freight is removed in accordance with the shipment plans and within the time limits required by the clients and also the necessary fuel supplies, the combustible and lubricating oils.

~~The chiefs of the steamship agencies are setting the~~ periods for removal of vessels; they are issuing precise instructions which will secure their safe removal. Along with these measures they are working out a detailed plan of disposition of the vessels which they do not intend to use, in placing them in the wintering bases and repair such plan with plan that their full anchorage safety and timely repair be secured. As the volume of shipping is reduced, the excessive tonnage is removed from operations and is being prepared for the winter repair or anchorage.

For the vessels assigned to navigate in ice conditions, and especially for the icebreakers, the corresponding supplies of high quality fuel and lubricants is built, the crews of these vessels are provided with warm clothing, and inventory for cultural pursuits.

The port chiefs check the replacement materials stored in the warehouses. They are strictly held for the keeping and completeness of the permanent supply of the replacement installations and materials, assigned for lifesaving purposes, and do not permit the scattering or use of the equipment for some other purposes and in proper time they complete the reserve supplies for Arctic navigation. The inspection

chiefs of the port supervision, the port captains are systematically checking on the presence of the damage-replacing supply and their readiness for prompt distribution of same to the ships sent out with the task of lifesaving operations.

Section 13. The Organization of the Icebreaker Towing of Ships.

In each particular case, depending upon the number of the ships towed through the ice channels and the distance at which the guidance is performed, the Minister of the Seagoing Fleet, and in case of a restricted volume of operations - the director of the steamship agency appoints the chief of the icebreaker operations. The candidacy for the position of the chief of the Icebreaker Operations (guidance through ice) is submitted to the Minister of the Seagoing Fleet usually by the chief supervisor concerned with the safety of navigation, from the number of captains who are possessed of experience in the navigation through the Arctic region. If the volume of the icebreaker operations is rather small, the duties of the chief of the icebreaker towing are laid upon the captain of the port or the chief of the steamship operations. From time to time the Minister of the Seagoing Fleet places the duty of guiding the ships through the ice and broken channels upon the chief of the steamship communications.

The chief of the icebreaker operations is appointed for the duration of the icebreaker campaign for a particular section of the sea and for the entire basin. In the operative matters he is subjected directly to the chief supervisor on sea navigation safety, or upon the chief of one of the main offices of the Ministry of the Seagoing Fleet (by the order of the Minister).

The chief of the icebreaker towing will directly guide the operations in the corresponding area and is responsible for their successful execution.

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The orders of the chief of the icebreaker operations in the matter of the towing of the vessels through the ice channels are obligatory for all the persons connected with the navigation of ships operating in the ice, and can be cancelled or changed only through the order of the Ministry of the Seagoing Fleet, by the chief supervisor on Safety of Sea Navigation, by the chief office or the director of the steamship company, to which the chief of the icebreaker operations is subject.

The activity of the chief of the icebreaker operations is governed by a special decree, by the instructions issued by the Ministry and interministerial committees, and by regulations of same (thus, for instance, the main seagoing inspection of the Ministry of the Seagoing Fleet has been confirmed on the 12th of November 1951 in the "Instructions to the Chiefs of the Icebreaker Operations of the Ministry of the Seagoing Fleet").

Only those vessels are authorized to do towing in the ice, which are not subject to limitations of the USSR Sea Register for sailing in the ice conditions.

In his work the chief of the icebreaker operations is guided by the code of commercial sea navigation, by the regulations for the ships towed by the icebreakers through the ice, as they have been promulgated in the Sailing Directions, by the Minister of the Seagoing Fleet, in their reference to the problems of guidance and sailing of the vessels in the ice conditions.

The chief of the icebreaker operations is the supreme authority in the operative activities, over all the icebreakers, the icebreaker towing launches, the freight-carrying auxiliary and other ships assigned for operation in a given area, from the moment of the beginning of the icebreaker campaign and up to its end.

The vessels of foreign organizations operating in the area under the authority of the chief of the icebreaker operations, are also subject to him in accordance with the special decree promulgated by the Ministry of the Seagoing

Fleet, together with the organizations which are the owners of said vessels.

If the area of the ice guidance is serviced by reconnaissance planes and ships, by special radio stations, synoptic and ice intelligence bureaus, they are also subjected directly to the operative authority of the chief of the icebreaker towing. The chief of the icebreaker towing is directing the organization and the execution of the ice conditions reconnaissance, watches systematically the course of the synoptic processes, the movement of the ice masses, break-up of the ice and the freezing of a certain water surface. He is checking on the information contributed by the ships sailing in the area under his authority, and also investigates all the intelligence leading up to the successful and safe navigation of same.

The chief of the icebreaker operations organizes the dispatch connection with all the vessels operating in his area, with the corresponding steamship agencies, ports, main offices, and is also active in cooperation with the chiefs of the icebreaker operations of the adjacent areas, in all problems pertinent to the organization, operations and tactical moves.

The chief of the icebreaker operations has the right to check on the condition and ready availability of all the means assigned for execution of the plan bearing on the icebreaker towing of ships, - he can issue orders to the captains of the vessels engaged in operations in the area of the towing, demand accurate execution of the tasks and diagrams of the trip, insist on accurate execution of the measures on the part of the organizations of the seagoing fleet disposed within the limits of the given area. This is done with the purpose in mind to secure a successful towing of the vessels through the channels broken through in the ice areas.

Along with this the chief of the icebreaker operations has the right to demand also from the foreign organizations, the ships of which are sailing in his jurisdiction the precise execution of his orders and the regulations set up for this area of ship conduction. Quite often the chief of the icebreaker operations is liable for the check-up of the

ports with a view to establishment of their readiness of accommodations and also of the points in the area for freight-carrying operations, the preparation of the bases for supplying the vessel with coal and water. He checks on the preparedness of the icebreakers and sometimes of the freight carrier fleet (wherever this is possible) for the execution of their respective operations, he is determining its technical condition and security with the necessary means and provisions.

The chief of the icebreaker operations further issues the order about the inception and termination of the ice-breaker campaign and is advising the steamship agencies, ports and captains of the vessels through the Hydrographic Sections of the Fleets by promulgating the order in the "Sailing Directions to the Mariners" (NAVIM). In these directions the chief of the icebreaker operations is publishing the order of issuing of the requisitions for the conduction towing of the vessels through the ice and the serial order of the guidance.

It is the duty of the chief of the icebreaker operations to guide the icebreaker operations both in regard to conduction on the sea as well as bearing on the port operations, so that the conduction of the vessels within the limits of the water surface of the port, the chief of the icebreaker operations carries it out through the corresponding captains of the ports.

The chief of the icebreaker operations is duty bound to take all the rational measures leading to quick and safe conduction of the vessels through the ice channels. If some vessel while being conducted by the icebreaker, suffers damage and the captain of this vessel needs aid, the chief of the icebreaker operations must provide such and direct all the lifesaving operations under the provisions prescribed in the code of the commercial sea navigation.

In the matters of injuries and damages caused by the ice, the chief of the icebreaker operations is guided by the "Regulations for Vessels Towed by the Icebreakers Through the Ice".

The chief of the icebreaker operations has the authority

to submit to the supervisor to whom he is directly subordinated, persons who distinguish themselves at the towing of the vessels through the ice for awards, and those violating the rules of navigation in the ice - he can report for administrative punishment.

In large scale icebreaker operations the operative direction is conducted by a staff organized in the office of the chief of the icebreaker operations. Members of the staff are employees engaged in the operations of the fleet and ports, scholars, synopticians, hydrologists, liaison specialists and fliers. The organization of the staff and its preparation for the execution of the assigned tasks is a matter of duty throughout the preparatory period, of the chief of the ice conduction.

The several groups are represented in the icebreaker conduction staff in case of large line operations, such as: the operational - dispatching, scientific, aviational, liaison and special groups. Alongside with this in place of the groups there can be only one specialist for each field of operations, and one specialist can also represent several fields of operations. In relatively small fields of the ice conduction some functions can be assigned to the corresponding members of the service crew and to the corresponding sections of the steamship agencies, for example, the operative-- dispatching functions can be assigned to the service or section of operations, the organization of the liaison, for instance, can be assigned to the liaison service, etc.

The duty of the chief of staff of the ice navigational operations is the organization of the smooth work of the staff, making of plans and diagrams for ice conduction of vessels, and the supervision of their execution, further the organization of the ice reconnaissance, the ice and weather service operations as well as dispatchers' liaison. The chief of staff is collecting systematically information from the captains of the ships, from the coastal stations and airplanes about the navigational - hydrometeorological and other conditions in said area.

On the basis of the decisions of the chief of the icebreaker towing, the chief of staff personally directs the

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work of the scientific group attached to the staff, he checks on the fuel supplies, as well as on the water supplies at the provisioning bases.

The chief of staff is authorized to issue orders and dispositions in the name of the chief of ice conduction, demand submission of the necessary information and reports.

Depending upon the scale of the ice towing of the ships, actual set-up and nature of the work, sometimes the assistant chief is appointed for the task of ice conduction as well as the deputy chief of staff.

If the area of the ice towing of the vessel is serviced altogether by one or two planes, then, naturally, there is no need for organizing the flier group. An experienced pilot (in case there are two airplanes on the ground, one of them is appointed senior) submits to the chief of the icebreaker operations, with the aid of a hydrologist the reports on the ice reconnaissance directly, or, by his orders, also to the captains of icebreakers and freight vessels which are navigating independently.

The chief of the icebreaker operations likewise takes the operational account and liability in regard to the towing operations and the activity of the icebreaker freight-carrying fleet and on all the means of assistance given it. He also organizes the systematization of the experience of the icebreaker operations, and submits a full summary account about the work.

The chief of the icebreaker conduction operations, ~~xxxgh~~ together with his staff or assistants, depending upon the conditions, can be quartered on the coast, or on a leading icebreaker, and sometimes, in especially complicated conditions of the towing operations, also on board an airplane.

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Section 14. Reception & Chartering of the Vessels Assigned to Navigating in Ice Conditions.

The freight-carrying vessels where they are engaged in operations in the ice conditions, can be utilizedirectly by the steamship agency in the port to which they belogg, or can be chartered to some specialised organization. The formal reception of the vessels in charter by the freight agents from the steamship agency and return to the steamship agency following the termination of the trips in the ice conditions, is carried out by a special committee or authorised agent, appointed by the freight owner and the corresponding steamship agencies, both in the reception and return ports, and, as far as possible with the participation of the representative of the USSR Maritime Register.

The committee setting down to work in the matter of the reception of the ship, is checking in the first place, the ship papers - the certificates: on its seaworthiness, the measurement data, the radio station, sanitary conditions, authorization by the USSR Maritime Register for the vessel to navigate in the ice conditions, a certificate of the load reception instruments, the act of the USSR Maritime Register, about the certification of the vessel, etc.

Afterwards the committee is carrying out a very accurate inspection of the ship hull, the deck, the load shipping apparatus, the machinery, and inside the premises. It gives a very detailed report on the condition of the vessel on especially provided forms at the time of the reception of the ship.

All the irregularities, injuries, detected during inspection, and also remarks in regard to the provisions, equipment of the ship and the complement of the ship crew, are all marked down in the official papers. Whatever serious defects have been discovered, which can affect adversely the navigation in the ice conditions, the chief of the committee immediately reports to the freight owner and the director of the steamship agency.

When returning the ship to the steamship agency, the

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committee marks down, on the basis of the reports made by the ship captains in proper time and notations in the ship log, of the injuries caused to the vessel, and point out specifically the volume of damage and through whose fault it has been caused.

In the reception - return papers concerning the vessel one must unfailingly mark the time and place of the reception - return, the quantity of the fuel available, of the fresh water and lubricants. At the reception of the vessel in charter and its return to the owner the damage done to the hull, that has been detected by the committee, is placed on the blueprint of the hull, a copy of which is sent, together with the ship papers to the freight owner.

Below we present a specimen of the reception - return paper in chartered use for navigation in the ice fields.

STATEMENT

Reception ________________________ for charter.

Port ____________________________ 195- Month ________________

We, the undersigned, on one hand the Committee of the Freight Carriers in the person of ____________________, in force as based on the proxy No ______________ of __________ 195-, issued ________________, and as the second part the Committee ____________________ of the steamship agency in the person of ____________________ acting on the basis of proxy No. __________ of ______________195-, with the participation of the representatives of the USSR Maritime Register ________________ and representatives of the Ship Administration in the person of the Captain of the ship, Comrade __________ __________, Senior Engineer, Comrade ______________ have drawn up this statement for reception in the chartered use by the said steamship agency under the terms stipulated in the Agreement ____________________________ and ____________________

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A. Inspection of the ship has been made in the Port of _____________________.

B. Floating at the draft: of the stern __________ of the bow __________________

C. The place of the last docking of the ship ________

   a) brought into dock "________" __________ ____________ 195-

   b) removed from the dock "_________" ___________ ____________ 195-

D. Beginning of the chartered operations "__________" ______________ 195-

The ship has been found in the following technical condition:

1) the stem (the presence of distortions of the stem, of the weak, hanging corroded rivets, condition of the sheet adjacent to the stem, and of the stamping);

2) the forepeak (the number of bent, cracked, hollow and chassis frames, the bent floor and connection ties, the knees and floors with cut angle bars or beams, rivets, bent beams, bent or cracked stringers, the general number of loose rivets, the volume of water incoming per hour, the presence of cement boxes);

3) the plating of the hull (the sum total of weakened and corroded rivets along the entire hull, with the exception of the forepeak and stern peak which are specified separately); the presence of the bents, their location, the surface of the bent-in places and arrows of turns, the presence of cracks in the sheets, their width and length, the rust and corrosion of the plating. The traces of the former repairs are stated separately; there is an especial marking of the corrugation of the hull

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and its area, the condition of water-tightness of the plating and the presence of the cement boxes along the entire hull, the condition of the frame work of the hull with the indication of the defective spots (for determination of the area of injury indicate the serial numbers of frames and of the plating belt);

4) stern peak (the number of the bent, cracked, hollow and chassis frames, of the bent floor and connection knees, the knees and floor with the cut-off angle bars or beams, rivets, the number of loose rivets, the water volume as it comes in per hour, the presence of cement boxes);

5) the hawsers (the presence of the cracks and other defects);

6) the anchor chains (worn condition of the links, the number of missing and the percentage of the torn-up counter supports, the number of junctions of each anchor chain, the time when inspection of the anchor was made by the USSR Maritime Register, and the date of their painting);

7) anchors (the number, the weight of same and the presence of injuries);

8) the lateral keel (the presence of injured spots, of the corroded and weakened rivets);

9) transversal bulkheads (the presence of the bents, the faulty water-tightness);

10) the second bottom (the presence of the bumps and other injuries, corrosion and lack of watertightness);

11) stern post (the presence of twists, the number of weak, corroded and leaking rivets, condition of the sheets of the plating adjacent to the stern post, their riveting, the presence of cracks);

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12) the rudder (twist of the rudder vane, clearances between the pintles and bushings, clearances between the loops of the rudder and the rudder post, the twist of the rudder rod; make a special note if the rudder rod has been done over);

13) the screw (the presence of the twists or injuries to the blades, corrosion of blades, cracks, traces of welding of the edges of the blades; the metal from which the frame has been made; the number of blades of the screw; the permanent and dismountable blades; condition of the cementing of the blades and the bolts of the screw);

14) propeller shaft (the condition of the deadwood bushings - are they from bakelite or the white metal, clearance between the shaft and bushings; at the bushing filled with white metal, the condition of the cedar wall packing box is stated; the time of the last inspection of the propeller shaft and the deadwood bushing at the dock, is marked down; the water-tightness of the deadwood packing box, the presence of twists of the propeller shaft);

15) kingston valves (the presence of the injured grates and other defects);

16) the plating of the false sides (presence of bents and other injuries);

17) railings (the number of bent or weak railings; the general condition of the railing is marked down);

18) superstructure (the presence of bent or broken walls and other injuries);

19) the lifeboats (the number of boats, the damage done to each of them);

20) searchlights (the number of the broken searchlights, of the broken glasses or those that are cracked);

21) radio station (technical condition);

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22) painting of the hull (the time of the last complete painting of the hull and the condition of the paint);

23) the windlass (technical condition);

24) the winch (technical condition);

25) the rudder apparatus (technical condition);

26) the mechanical instruments installed on deck (technical condition);

27) the freight loading and containing devices (the technical condition of the booms, of the running and permanent tackle);

28) other injuries (damaged ventilators, the light hatches, of the windings and other details and installations located on the deck of the vessel, which can be damaged while the freight loading operations are on);

29) ~~bx~~ boilers and engines (technical condition);

30) the balance of the coal and liquid fuel (one puts down as firmly established the quantity of same) available on board the ship at the moment of its reception for charter);

31) the balance of the machine oil;

32) the balance of the cylinder oil;

33) the balance of the motor oil;

34) remainder of kerosene;

35) balance of the rubbing alcohol;

36) balance of the water;

37) general remarks on defects which had not been indicated in the points specified above;

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38) the ship papers available on the day of the chartering of the vessel (the documents are specified);

39) remarks about the lacunae in the report concerning the hiring of the crew, in regard to the ship supplies and food supplies (to the statement the list of the crew and the bookkeeping sheets of provisions are attached);

40) the following documents are attached to the statement (listing of the documents);

41) the ship should be considered as chartered (indicate the year, month, day and the local time).

This statement has been drawn in "______" copies, which are directed:

____

____

The above stated points of agreement are affirmed with our personal signatures.

Signed by the representatives of the freight agent:

1. ______________________________

2. ______________________________

3. ______________________________

The representatives of the ______________ Steamship Co.

1. ______________________________

2. ______________________________

3. ______________________________

The representatives of the Ship Administration of the accepted - chartered vessel:

1. Captain ____________________

2. First Mate ____________________

3. Chief Engineer ____________________

Section 15. Duties of the Ship Captain in the Conditions of Ice Navigation.

In accordance with the regulations the captain is the fully authorized manager and organizer of the operations on board the ship, a trusted person of the Soviet Socialist State, a person, to whom the ship and the life of the persons aboard have been entrusted, and also his personal and exclusive administration on board the ship has been entrusted.[1)]

Let us analyse the basic duties of the captain immediately attached in regard to sailing in ice conditions.

If the vessel is chartered while sailing in the ice conditions, the captain is subordinated, from the moment of the take-over of the ship by the freight agent up to the moment of its return to the ship owner, in regard to the matters of operational set-up, and only in the administrative matters he is subordinated to the owner of the vessel, that is the corresponding ship agency. During the trip the captain of the vessel is subordinated to the captain of the leading icebreaker and to the chief of the ice conduction.

Footnote 1: "The Statute of the Service on Board Sea-going Ships of the Fleet of the USSR", Article 61, "The Maritime Transportation", Moscow - Leningrad, 1950.

In addition to the statutes and regulations of the technical use of the vessel, the captain of the ship is guided throughout the season of the Arctic navigation by the regulations for the ships guided through the ice areas.

Along its full course of sequence the captain (or his First Mate) makes a thorough inspection of the changing ice conditions, and describes their condition in the ship log. If the ship is sailing on its own, the captain, besides notations made in the ship's log, reports also on the ice situation on a special ice chart. The captain takes all the necessary measures in order to avoid any possible injury during the maneuvers in the ice areas, and as it is following the icebreaker it should keep its position in the echelon without interfering with its progress.

If on its course the ship suffers any damage, the captain of the ship must take all measures toward its repair, possibly avoiding delays or stops in the progress of the ship.

The captain marks it down in the ship's log and the corresponding official statements all the actual or assumed ice injuries with the indication of the time, place and conditions, in which the damage had occurred, and also describes as far as possible, the nature of the damage, its exact location, size, etc.

All data concerning the damage caused by ice the captain reports immediately (without waiting for the next successive report) to the director of the ship agency, to the chief of the ice convoying and to the captain of the senior icebreaker, and if the ship sails under charter, also to the freight owner.

One should take into consideration that usually by the terms of the contract for chartering of the vessels for Arctic navigation, it is provided that in case the freight owner has not been notified (or notified past the proper time) on the ice damage sustained by the ship, the freight owner will not be liable for any damage.

In the course of navigation the captain must admit to the commanding bridge and the pilot's cabin the scientific

workers appointed to the vessel for execution of the work connected with the study of the ice and the ice situation, and also cooperate with them in the execution of the work assigned to them.

Throughout the time of the ship's stay in the port or at freight loading points, at the places of their unloading or bunker supplies, statements are made of the time spent, with the signatures of the interested parties or representatives of the port, indicating the quantity of the loaded or unloaded freight or fuel and the time actually spent in this operation. In addition to that they have to draw up papers concerning the immobility of the vessel because of the ice conditions or weather situations, or for some other reason (specified). By the time the ship is returned from the chartered condition, the captain draws up a detailed report on the trip and navigation, in which he describes not only the work achieved, but also describes the proposals and suggestions in regard to the improvement of the ship's operations; he marks down the specific properties of the area of the Arctic navigation.

When making up his report on the trip the ship's captain is guided by special instructions. Besides this the captain must submit, along with his report on the trip, also the ice charts and the notations contained in the watch log for the entire time of the trip.

Section 16. The Reports of Captains on Their Trips While Sailing in the Ice Conditions.

In each area of the navigation in ice there are some specific features. For a successful navigation in the ice conditions it is necessary to study continuously the local conditions, to improve the coastal means of the sailing enclosures, to have accurate charts, and instructions to the mariners, accurate data on the behavior of the compasses and the electro-navigational instruments. The conditions of

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navigation even in the same area may be different in different parts of the year and also on different courses, and by far not all the captains have the convenience of personally studying the manifold conditions of the Arctic navigation.

This lacuna is filled with the reports of the captains on the trips, on the basis of which the steamship agencies are drawing general conclusions in regard to organization of the navigation in the ice areas. By studying the trip report, the captains can considerably complete their knowledge on the conditions of ice navigation in general, and in particular in a certain specific area.

The captains of the vessels navigating in the ice conditions, must draw their reports with minute detail, with exhaustive description of the ice situation, and attach the ice charts and the diagram of the trip on blueprints or a special chart, blank chart (in case the navigation was undertaken under its own sponsorship). In the trip report one must put down considerations relating to the sailing behind the icebreaker, they must evaluate the operations of the icebreaker and make detailed notes in regard to the whole navigational set-up.

The captain points out in the trip reports the detected deviations in the characteristics of the beacon lights, of the sound signals in the fog, in the color and appearance of the lighthouses marked down on the chart and in the Directions to the Mariners. They must mark down the observed range of day and night visibility of the lighthouses, beacons, and markers, the time of their detection and the directions, the course, corrections of the compass, the place observed in the moment of their opening or closing off of the lighthouse, beacon, or reversal of the marker, the elevation of the observer's eyes, the meteorological and ice situations;

Especial attention must be devoted to the distance of the audibility of the sound and fog signals. In the reports one must under all circumstances point out the time of the emergence and vanishing of the audibility, the direction, the course, the correction, the observed position of the ship, the meteorological conditions and the ice situation.

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Besides this the captain will issue indications in regard to improvement of the sound characteristics, and also precise determination by the radio direction finder and conditions of the passing of the radio directions; he must make suggestions in regard to the new means of enclosures, installation of additional lighthouses, beacons, markers, sirens, nautiphones, radio beacons, etc., marking off their desirable action range.

In connection with the fact that the navigation in the icy regions is not carried out by recommended courses, it is necessary to indicate in detail, all the discrepancies on the charts in regard to the depth, the outline of the coast, the landmarks standing on the coast. This should be done in the said trip report. One must indicate which are the landmarks, the presence of which would contribute to the improvement of conditions in regard to determination of the ship's location without being pointed out on the chart.

If in addition, the ship carries out the soundings on the trip, then one should attach to the trip report all the materials, needed for reconstruction of the ship course, and the markings of the obtained depths on the charts: the measured depth, the courses, corrections of the compasses, deviation tables, observation tables; in addition to this one should indicate also the instruments with which the depths had been measured, and the corrections on these instruments that have been made. In case the ship has on board an echo sound, the captain will produce his notations on the bathogram with the indication of the meteorological conditions and the blueprint or the chart of the navigation area.

In his trip report the captain must also indicate the content of the sailing instructions - he must point out the discrepancies in the text, and indicate which sections of same should be completed; he must offer suggestions about the printing of the charts, their scales, the location of the additional drawings, of auxiliary tables and give advice for the issuance of the new navigational aids. The captain must also give the characteristics about the work of the compasses and electronavigational instruments; he must point out his desires in regard to the change of their construction.

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In his trip report the captain must describe the conditions in which the ship operates at each point of call, remarking what, in his opinion, must be done for the improvements of navigation, loading, unloading, bunkering, water supply, etc. If the freight operations are carried out on roadsteads, then to the trip report one must attach a diagram for the anchorage of the vessel, and if possible, also indicate the surrounding depths, the convenient places for unloading it ashore at different winds and ice conditions, and also places where the freight can be stored, as well as desires in regard to shore installations to expedite both the loading and unloading of the freight.

Next to his trip report the captain of the vessel is also giving an account on the trip on the conventional form. All data submitted in the trip report, must strictly comply with the attached documents, in particular the notations made in the ship log and the machine log, in the radio journal, in the statement on the use of time, and others.

Section 17. Measures Against Freezing.

Before his departure for navigation in the ice covered areas the captain of the ship or the physician of the ship must acquaint the members of the crew with the measures of freezing and the methods of giving first-aid to the person stricken with the freeze, and during the trip they must systematically check on the condition of the clothing and footwear of the crew (especially of the persons keeping watch on the commanding bridge, in the crow's nest, or on the forecastle for observation of the ice conditions).

Let us stop briefly to muse over the phenomena of freezing and the recommendations how to avert them. At low temperature in the unprotected part of the body the blood vessels sharply narrow down (the spasm of the blood vessels), the regular blood circulation is upset.

True enough, the freezing is observed sometimes also

at a temperature not much lower than zero, especially in heavy wind and moist air. In the given case the damp clothing and footwear contribute more than anything else to the freezing, since the moisture considerably lowers their warm protecting properties.

The freezing usually begins with sensations of pinching or sticking. The skin sharply pales, loses its sensitivity, and the sufferer frequently does not notice the first signs of frostbite. If the place that became pale is promptly rubbed well, in order to restore the blood circulation, the phenomena of freezing disappear. At the first stage of freezing after the warming,xx the skin in the frozen place becomes blue - red, sickly and swollen. For several days a considerable sensitivity of the frozen spot lingers in regard to the cold with some slight swelling.

At the second stage of freezing the skin develops blisters filled with a transparent or muddy blood-shot liquid, the skin assumes all around a blue - red shade. At the third degree of freezing on the body, in addition to blisters, the skin develops scabs. On particular sections of the skin and even deeper, in the tissues, the blood vessels' supply ceases and deadening of the area (gangrene) sets in. The general freezing begins with the feeling of chill, sluggishness, fatigue. Thereupon a condition of sleepiness sets in which is hard to overcome, the extremities become rigid, the heart action weakens and death sets in.

Naturally the above expounded division is to a high degree conventional. The most frequently the various degrees of morbid changes of the tissues combine, so that the freezing sets in so imperceptibly that it is very difficult to establish its inception.

It is very difficult to combat the consequences of the freezing. Sometimes they are kept throughout the person's life in the form of the increased sensitivity to cold and swelling, which appear on the very first subzero days. One must remember that it is much easier to forestall freezing than to heal it. The most effective means against freezing is the systematic hardening of the body. The daily morning exercise on the deck or at open hatch, the rubbing of the trunk of the body after exercise with cold water, builds up

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a resistance in a person so that he becomes less subject to freezing.

However, the most hardened and freeze-resisting sailor should not disregard the basic measures of forestalling the freezing. The clothing must be snug and well protected from the wind, it must not handicap the movements, especially while working with the cables, the clothing must be perfectly dry, all the buttons and hooks, and x latches must be in a perfect condition. The footwear must not be snug so that it could stand an additional pair of socks or footcloth. It is quite useful to insert in the footwear a felt or straw innersole layer. One should not lace the shoes too tightly, whether with shoe laces or foot cloths. Before coming out for watch duty one must well grease with some lubricants the footwear that had been very carefully dried; the best policy is to grease the shoes with fish oil, beef suet, mixed with tar, or with a special grease.

The socks and footcloths must be clean and strong. In case of leather shoes one should put on not less than two pairs of socks, one of them being made of wool. It is important to properly wind the feet with footcloths, avoiding wrinkles and edges. For additional protection of the feet from the cold one should recommend to wind over the first pair of socks with newspaper stock (without wrinkles and folds), and put on the second pair of socks or footcloths above the newspaper.

The cap must be placed tightly on the head, so that no wind should blow under it. While sailing in the ice areas the most difficult task is to protect the ears from freezing, since the captain, pilot and the chief scout, especially during the guidance by the icebreaker, must listen attentively to the sound signal. Therefore they use in most cases the sports headgear, above which they put on their fur caps.

They put on their hands leather, or in extreme cases, canvas mittens lined on the inside. The lining must be laundered and dried after each watch duty.

If the clothing, underwear, footcloths, socks and

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mittens are badly soiled and drenched with perspiration, their warm protecting properties are thereby considerably reduced. This is why it is necessary to launder the clothing as often as possible.

At the very low subzero temperature one can use a mask from light clean material, for the protection of the face. Besides this it is advisable to grease with non-salty grease, such as vaseline, pork suet, goosegrease, cow butter or special grease, the nose, ears, cheeks, chin and especially those parts of the body which are subject to freezing (such as the feet, the toes and fingers) before coming out on the bridge for watch duty. However, one should apply grease only on separate easily frozen sections of the body, since the grease interferes with the breathing of the skin.

In the conditions of navigation in ice areas the freezing cannot always be successfully averted. At its first symptoms one should take immediately the proper measures to be of assistance to the person so afflicted.

Before all one must rub the frozen parts of the body. One should rub it with a soft mitten or with the sleeve of a wool sweater very hard until the skin gets red and its sensitivity is restored. After rubbing one must grease the skin and cover it with a real warm object.

At a high degree of freezing, and also in intense cold, one must immediately deliver the patient to the nearest coastal point for medical aid, and if it is impossible, one should bring him to the icebreaker - for usually on board the icebreaker there is an experienced physician and everything available to help the patient. In extremely serious cases they usually consult through the nearest radio station for qualified medical advice, over radio.

Section 18. The Disposition of the Ships for Wintering.

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The seagoing vessels in the majority of cases are removed from their navigation work for the winter period at a time when they are requiring medium or overall repair and only in rare cases for some other cause (if it is not possible to remove the vessel from the navigation area before the full freezing because of the depth handicaps, in connection with the prohibition of the USSR Seagoing Register to operate the vessel in the winter conditions because of its structure or technical conditions).

As a rule, the seagoing vessels are being stationed for the winter period in the water areas of the dockyards or in the river estuaries. In the latter case the corresponding sections of the Regulations governing the internal waterways of the USSR, are applied in their full extent to the seagoing vessels. In accordance with these rules before accommodating the vessels for wintering in the river basin a plan is made up, which is coordinated with the ship inspection and the organs of fire prevention of the Ministry of the Seagoing Fleet and the Ministry of the River Fleet. In that plan there is a provision for preparation of the ships for wintering, the place of its anchorage, and also the order and the sequence of introduction and allocation of the vessels in the places of the winter station.

Among the number of the preparatory measures preceding the allocation of the vessel for wintering are the unloading of the coal supplies, cleaning of the tanks of the vessel from the remainder of the fuel and its refuse, of various rubbish and unnecessary materials.

The tanks for the oil products and lubricants, requiring repair, are cleaned dry and are being steamed. If however the tanks do not require repair work the remainder of the oil may be kept in same, however, this case being the tanks are sealed until the next trip of the vessel.

When a vessel equipped with a mechanical motor comes up for wintering before letting the steam go out, or before conservation of the internal ~~combustion-engines~~ combustion engines, the fire combatting water main is tested under full pressure. After the test it is further checked to see whether the water has been fully eliminated from the fire combatting main and pumps.

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As a rule the ships are taken to their wintering quarters in the order of sequence of their arrival. However in wintering over places which belong to some organization, the preference to the first place is given to the ships of the owners of the inlet. In so doing if the vessel belonging to some other owner had been stationed for wintering over ahead of that time, and by the conditions of the disposition of the vessel the owner of the inlet deems it advantageous to change the disposition of the stationing of the vessels, he is authorized to demand from the captain of the vessel that belongs to another owner, to change its place of anchorage.

The general guidance of the disposition of the ship in an inlet is effected by the chief of the inlet through one of his subordinate echelon captains. On the other hand if the vessels are accommodated for the winter not in an inlet, then usually one of the most experienced captains of the vessels spending their winter season, is appointed. He, in accordance with the situation, performs about all the functions which are entrusted to the chief of the inlet and the echelon captain.

The echelon captain is authorized to see that the ships be introduced in proper time and disposed in good order in the wintering-over place. If in the wintering area of the ships sent to wintering, navigation still continues, then at night-time the light signals are set up on board the vessels. On the vessels provided with a mechanical engine (in this case also sail - motor engines) a white light is hoisted at the edge of the commander's bridge from the front side which can be seen from three sides: from the cross direction, from the bow and from the stern. In addition to that, they set up white lights on the taffrail and in the rudder cabin.

On board the vessels which are not provided with propulsion machinery, and on sailing vessels less than 75 meters long, during their wintering station raise a white light on the mast; on board the vessels of 75 meters and more, further on the flat-bottom barges, besides one white light on the top of the mast, they raise one more light on the bow and on the stern each at a height of not less than

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two meters from the side.

On the vessels shipping oil products of the first, second and third class, explosives and inflammable loads, during the time of their wintering over will also raise such supplementary lights as at the time of their sailing, that is, independently from the size of the vessel, if it ships oil produces inflammable loads with the blast temperature below 28° C, they raise two red lights on the mast and two white lights, one on the bow and the other on the stern. In daytime the red lights on the masts are replaced with two red square flags, one square meter in size, at a distance of two meters, one from the other.

On board the vessels without motors or engines, which ship oil products of the second or third class with blast temperature above 28° C, and also inflammable self-igniting loads, independently from the size of the vessels, raise at nighttime a red light on top of the mast and two white lights, one on the bow and the other on the stern. In daytime, on board such vessels, they raise one red square flag one square meter in size.

If the oil tankers, sent to wintering over, are fully cleaned and steamed, they raise the same signal as the other dry-goods shipping vessels.

If the ships are sent to wintering anchorage in arrangement of a continuous echelon, that is, in such a way that there is no passage between them and the shore, then the above said lights are raised on all the affected vessels. Besides this, on the bow of the former and on the stern of the latter ships of all classes they raise one supplementary white light at two meters' height.

Especial attention at the disposition of the vessels for wintering over must be devoted to fire combating measures. Immediately after the arrival of a vessel to the wintering place a special committee is making an investigation on board the ship in regard to fire safety. The membership of this committee consists of the representative of the Main Office of the inlet or the stationing point, of the fire combating organizations and the steamship inspection office.

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If the wintering station is not in an inlet, the committee is appointed by the senior captain from among the membership of the crews of the wintering ships.

In the statement describing the inspection, the defects are indicated which have been detected, the time period for elimination of same, and the persons liable for those measures.

After the ice has been firmly settled, the same committee makes the second investigation of each ship separately, of the groups of the ships and of the entire inlet, and in so doing establishes and marks in the form of the statement the ~~mam~~ fire combating measures, which are practiced by the administration of the inlet, wintering stations or by the higher command of the ship.

In the course of winter repair work the captains of the ship and the representatives of the fire combating crew take good care so that the defects described in the statement, be eliminated in the assigned periods of time. About the violations of these time periods, the captain, the skipper and the representative of the fire combating crew, make a report to the administration of the inlet. The chiefs of the inlet or the senior captain, together with the organs of the fire-combating crew are setting up the regulations for the internal disposition, directed to the elimination of the fire hazard and report them to the crews of the ships, and also to the workers and employees engaged in the inlet.

The roads laid out on the ice surface between the lines and groups of vessels and to the ice holes serving as fire stations with water and also those from the coast must always be free and convenient for rapid passing of the fire-combating crew. At the places of wintering of the ships the chief of the inlet, in concurrence with the organs of the combating the fire hazards, assigns daily the vessels for the fire security. Usually these are the vessels with mechanical power installations, Cameron pumps, donkeys or other fire-fighting and water pumping means, as well as other installations to fight the fire hazards.

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If the vessels stationed for wintering over are heated, only coal can be used as fuel, or the oil with the temperature of blast not below 65° C.

Depending upon the degree of fire hazard all the wintering stations of the vessels are distributed into groups. For each of these groups the standards of equipment with fire combating means, appliances and inventories are determined. The number of the fire combating inventory and the places of disposition are set up by the organs of the fire security, depending upon the local conditions.

The wintering over vessels are protected by the watches which in accordance with the post and fire security instructions are following strictly the rules for fire fighting and immediately give signal about the starting of a fire. The trash, the mazuth dirt collecting on top of the ice cover in the area of the anchorage of the wintering-over ships, are removed daily from their place, in the area which is safe from fire, both in regard to ships and the coastal installations. In the inlet in public places the fire safety regulations are exhibited. The places of the echelon wintering in the inlet, the watch duty premises and the fire security storehouse are equipped with a telephone network, with light and sound signaling.

It is of great, often of decisive importance to have the ships arranged at the proper distance (the distance between the vessels) depending upon the nature of the operations carried out on board same. Thus, the ships requiring the drying of their bottom on scaffolds must be kept apart at a distance of not less than 30 meters away from other ships and structures. The ship, the floating platforms and other craft and their installations, with the aid of which the fire instruments are used in the process of the work, must also be stationed apart, at a distance of not less than 100 meters away from the ships and structures.

The ships which during the winter season are loaded up with freight, or where such freight is unloaded, which may create fire hazards (with the exception of all the oil

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products of all classes), are set apart in groups at a distance of not less than 100 meters away from the other ships, storehouses or heated shore premises, with the distance between the sides of the vessels in that group of not less than 10 meters. The ships with other loads are stationed at a distance of 30 meters away from each other. The ships with the oil products of the first and second class and also loads with explosives, as a rule, are stationed for wintering over in a special inlet.

If for some reason or other the necessity arises to place the ships carrying oil products in the common inlet, the following rules have to be observed:

the vessels loaded with the oil products of the third class with the temperature of combustion over 45° C, and also empty vessels which carried such loads, as well as oil transfusion stations, are placed at a distance of at least 100 meters from each other and from other vessels;

the vessels carrying oil products of the second class with the combustion temperature of 28 to 44° C, and also empty ships which carried such loads, are disposed at a distance of not less than 200 meters from each other and from the other ships;

the vessels carrying a cargo of oil products of the first class with the combustion temperature below 28° C are disposed at a distance of not less than 300 meters, while the ships carrying explosives - should not be less than one kilometer from each other, and from the other ships.

After arranging the stations of all the ships for wintering over the organs of the fire combating tasks will promulgate the day of the general prohibition to keep fire on board the ships. From that day on the work with fire on board the ships can be effected only with special permission of the fire security organ, and in the absence of the fire brigade - with the permission of the senior captain. The

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work for drying of the vessels can be affected only with the permission of the chief of the inlet and the fire protecting organ. For drying of the vessels the cast iron furnaces are used and only in extreme cases the burning of coal is permitted in the firepots. In this process the dried out portion of the vessel is enclosed with special shields.

The iron work operations with bellows in the hulls of the ships can be conducted only with the written authorization of the chief of the inlet and of the organs of the fire-fighting brigade. In so doing the use of the fire bellows is permitted only with safety hoods and with the enclosing shields. On board the ships, which still hold the loads with fire hazards and are not ~~xxxx~~ cleared yet from the remainder of such cargo, the operations with fire are not permitted.

Each inspection of the holds and tanks which had contained oil products, is carried out under the immediate supervision of the chief of the local fire brigade and with the use of the electrical accumulator flashlight of the safe type, with protecting means of magnetic devices.

The fireplaces for the cooking of tar, heating of the instruments, etc., are not permitted in the inlet except at a distance of 100 meters from the wintering over ships, while these camp fires must, under all circumstances, be enclosed with shields or a wall built of snow at the corresponding height.

Navigation on the regular sailing lines is in operation, continuously, from the moment of their deliverance from the ice and up to the moment of their being frozen in, while on the waterways temporarily used, with the aid of the icebreakers - throughout the period of their use. The dates of the opening and closing of the navigation season are determined by the main offices of the basins, in accordance with the steamship agencies, and are promulgated in the information sheets of the main office of the basin of the lines. The directing organs of the lines will inform in proper time the captains of the ships and the raft driver through dispatchers, the chiefs of the stations and by all

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other possible means (in the ~~fx~~ information news, through the supervisors of the set-up, captains of the ships, etc.) about the opening of the navigation and the cancellation of the regulations, as well as about the changes in the set-up and disposition of the signs and their lighting.

Section 19. Protection of the Ships From the Ice Floe.

In order to protect the hulls of the ships wintering in the rivers, from the moving ice masses, in the wintering over area a sector is selected which is well protected from the ice floe (a cape, a natural abutment, the estuary of a confluent of a small river), and they guide there the ships by icebreakers (or in some other way).

If in the area of the wintering over of the ships there are no natural or artificial retirement places for the protection of the hulls of the ships from the ice floe, one can use any of the methods specified below.

One can install the ice cutters; however, this method for the protection of the ships, even though it is fairly reliable, it is time consuming and expensive. It is more advantageous to build a protective ice dam. After the ice is finally settled at the spot which has been selected for the damming purposes, under a 70 - 80° angle to the shore line, two snow walls are built from 2 up to 10 - 15 meters high. The channel formed between these walls is filled up with water up to 15 cm in height. As the water freezes in, additional water is poured until the channel is filled with ice. In the spring the ice dam is covered with some isolating materials (moss, straw, sawdust). As the experience has demonstrated, a well equipped dam is a perfectly reliable protection and disintegrates only after the river is cleared of ice. The ice dam can have a streamlined form, in order

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to prevent the accumulation of ice around it. Besides this, it must be built so far as possible, in the widest portion of the river, then the stream of ice will freely pass by it.

The hulls of the vessels can be protected during the ice floe, also by a channel, which has been formed at a certain distance from the ship, by heating around the sides of the hull an ice crust which, so to speak, has been welded to it for its protection. The ice slabs in such cases pass along the vessel, without causing it any injury.

The channel can be made in any way, with the aid of explosives, with ice cutters, or otherwise. It is the most expedient to strew over the place through which the channel must pass, with fine slack. The slack is heated under sunshine faster than the ice, and the channel thaws clear in the necessary spot. In such a way channels are made for the removal of the ships from their wintering over stations.

CHAPTER IV

MUTUAL RELATIONS WITH THE CLIENTS DURING THE PERIOD OF ICE NAVIGATION

Section 20. The Method of Establishing Accounts for Use of Icebreakers.

The icebreakers of the Ministry of the Maritime Fleet are being rented by the interested government activities and are placed for the services of ship conduction through the ice, or for other operations (with the exception of life-saving) on the conditions of payment by the hour. The icebreakers are rented out on the basis of agreement between

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the corresponding steamship agencies or the ports or the chartering agents. The pay for the use of the chartered icebreaker is computed by the conventional cost of their upkeep with addition on the top of it of a 5% amount. The beginning and end of the charter are considered from the moment of the signing of the statements of both the reception and return of the icebreaker.

The fee for casual operations executed by the icebreakers is taken by computing the actual cost with the addition of 5% profit. The time of the icebreakers' service is computed two hours before its sailing toward the point indicated in the order, up to the moment of its return to the place from which it had been called out, or to the place of steady stationing on the basis of the official notice given by the clients to discontinue the services of the icebreaker.

The calls for the single conduction by the icebreaker, or for any other type of work, is made formal by submitting the order to the steamship agency, port or agency in the disposition of which the icebreakers are kept, or directly to the captains of the icebreakers, is it provided in the "Regulations for the Conduction of the Ships through the Ice by the Icebreakers".

It must be stated in the order: for what kind of work the services of the icebreaker are required, for how long a period of time, the date and the hour of its appearance, the points of assignment, the name of the ship requesting to be led through the ice, the surname of the captain, the full load capacity of the ship, the quantity and composition of the cargo. Besides this, one must indicate in the order that the USSR Seagoing Register issued the permit to the vessel navigating in the ice. The order is signed by the chief manager of the credit department of the undertaking which is requiring the services of the icebreaker.

The director of the steamship agency, the port, the agency, or the captain of the icebreaker, upon receipt of the order, confirms its acceptance for execution. If the

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icebreaker cannot be placed at the service of the client, the cause of denial is made known to him.

At the simultaneous conduction of a group of ships, if in their number there are ships representing the property of several government activities, the payment of the fees for the towing is prorated among all the vessels in the ratio of their full capacity of the cargo. As the basis for computation for utilizing the icebreakers, which had been chartered out, serve the contracts, while for the use of the icebreakers for a single occasion, - the order of the client, the abstract from the watch log of the icebreaker, the report issued by the operative section of the steamship agency, or any other agency. All the terms of accounts for the use of the icebreakers are regulated by the code of Commercial Sea Navigation and the decree governing the conduction of the vessel in the ice areas.

The heavy ice conditions sometimes deprive the ship, which had not been adjusted to sailing in the ice conditions, of the capacity to deliver the load to its consignee. Article 104 of the Code of the Commercial Sea Navigation of the USSR provides that "If by the consent of the certifying party the whole vessel is chartered and if it becomes impossible to enter the port of the cargo's destination, by force of the blockade, war, prohibition, ice conditions or any other cause, the captain must take his ship in one of the nearest ports, inform the dispatcher of the obstacle and wait there for his decision. In case it is impossible to do that within a reasonable period of time the captain has the right to unload the vessel or to return to the original port with the load aboard, - depending upon the circumstance which will be the more profitable for the dispatcher. In the latter case the dispatcher must pay for the freight in proportion to the distance covered by the ship".

Thus, the ice conditions preventing the vessel from entering the port of call for unloading or embarking, while it is safe to leave the port, are the circumstances which give the ship owners the basis for cancellation of the shipment contracts, or to unload the freight not in the port

of assignment, but in the nearest safe port.

In connection with the development of the icebreaker fleet, especially in the USSR after the Great October Socialist Revolution, frequently various other conditions are entered in the shipment contracts. Thus, when chartering the ships for the shipment of cargo in the winter season in the freezing ports, in the contracts there is a special ice clause, by which it is provided that in case the port is frozen in, the chartered vessel must proceed to same under the conduction of the icebreaker. It is a matter of course, that the effectuation of this clause frequently is connected with the additional risk for the ship and freight, due to the hazard of the ice injury of the hull. Therefore in the charter contract, providing the call of the ship in the frozen-in port, the parties to the contract especially enter into it additional points of mutual obligations and liabilities.

In the chartered conditions usually there is provision that if the port of embarkation is inaccessible, due to ice conditions or its freezing in, following the arrival of the ship, the chartering parties assume the unpaid obligation to place icebreaker aid to the cargo ship. The requisition for such aid must be declared by the ship captain, in accordance with the regulations about the conduction of the ships in the ice areas. In so doing the vessel must submit to the official instructions, regulations issued by the corresponding authorities in regard to the icebreaker aid.

The radio installation of the vessel at the time of the ice conduction, must be in a perfect order.

The assistance of the icebreaker is provided for the ship in the port 48 hours after the captain of the embarkation port was notified by the captain or owner of the ship, that the ship had come to the ice edge, and when the ship is leaving the embarkation port - 48 hours after the ship captain notified the chief of the port of his readiness to leave.

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In the period of waiting for convoying of the ship in the port or its removal from the port, the general time computation is used (reversible)[1].

If the waiting period of the icebreaker is over 48 hours from the moment when the captain of the cargo ship required assistance from the icebreaker, the time over 48 hours will be considered as delay through the fault of the chartering agent and is subject to payment in accordance with the effective rates. At the same time the freight sender does not bear any liability before the ship owner, nor is he liable for the loss or injuries caused to the ship, nor any delaying penalties, caused by the sailing of the vessel in the ice conditions.

However, circumstances may arise in the practical situations which will not permit the ship to enter the port or leave it, even with the aid of the icebreaker. Thus, if the vessel by its specifications, or due to wear of the hull is inadmissible for sailing in the ice; or if there is no icebreaker in the port which is sufficiently powerful for the convoying of vessels in the given ice situation, etc. For this reason in certain standard charters, for instance in the "Dzhenkon" charter, it is provided that if the port of embarkation became inaccessible following the arrive of the ship (froze in or is covered with heavy ice), the captain of the ship has the authority to leave without the cargo. In such conditions the shipment contract is considered cancelled.

In case there is the danger that the ship may be delayed for a long time in the ice areas, or in case it became subject to ice injuries, the ship captain has the authority to discontinue the loading or unloading and sail with the available cargo, in another port, for the loading

Footnote 1: The only continuous time computation for effectuation of the work of loading or unloading of the ship.

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or unloading of the cargo. In such situations a part of the accepted load will be shipped by the terms of the charter, for the account of the ship owner, while the owner of the freight will pay for shipment only of the unloaded quantity of the cargo.

If the charter provides the take-in of cargo in a number of ports, in the number of which one or several ports are closed because of the ice conditions, the captain or ship owner has the right to take in only a part of the load into a port that is still open for navigation and complete the loading of the cargo in another port. If the freight owners do not agree to embark the whole load in the port, open to the access of the ship, the captain or owner of the ship has the right to declare the charter null and void.

The above mentioned conditions are provided by a general exception clause in regard to ice as it appears in "Dzhenkon". In other charters also other provisions are inserted. So, for instance, in the charters made for the shipment of the timber ("Russwood", "Baltwood") it is provided that if the entire freight according to the charter must be loaded only in one port, while in this port, in connection with the ice conditions, the loading is impossible, about which the ship owner is advised by the dispatcher of the freight, through his own agent or captain, the charter is also declared null and void. The ship owner advises the freight agent of the cancellation of the charter by telegraph.

If the charter provides for several ports of loading and the call in the first port is impossible, due to ice conditions, the ship will, in accordance with the rotation provided by the charter (that is, the sequence of the calls) must be sent in the next port. The vessel may enter the second port, indicated in the charter, by the judgment of the captain. In such case the freight sending agents must either declare immediately the cancellation of the charter, or demand to have the cargo loaded in the port or ports specified in the charter, into which the call in the judgment of the captain, is possible.

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when additional loading of the vessel is necessary, in these cases one may carry it out in every safe open port of the same coastline, and in the same country, but not north of it.

In case it is impossible for the vessel to call in a port due to the ice conditions the captain whose opinion is considered above issue, establishes the fact. If, in the opinion of the captain the vessel in connection with the ice conditions cannot call in either of the ports specified by the charter, the contract is cancelled, which fact is made known to the freight owners over telegraph.

In the "Russwood" and "Baltwood" charters there is also the provision establishing the right of the captain to set out to the sea without load, if it is his conclusion that there is danger for the vessel being crushed by the ice masses. The charter in such case is cancelled, on which matter the captain passes on the word by wire to the freight owner. The captain is authorized to leave the port with a part of the load and be compensated for same in another port or ports, even though they had not been specified in the charter. In such a case the accepted part of the load must be delivered without delay in the assigned port.

The expenses connected with the loss of time by the vessel because of the ice conditions, are borne by the freight owners. The ice exception clauses in the charters lose their significance with the setting in of the spring when the ice in the navigation area of the vessel does not constitute unsurmountable obstacles.

The ice exception clauses are inserted also in the bill of lading. So on the reverse side of the bill of lading (form KS-55) it is indicated that if the load cannot be delivered and unloaded in the assigned port without hazards for the ship and cargo due to the ice conditions, the shipper is entitled to unload (for the account and risk of the freight senders) in the nearest port of call when it becomes possible, on which circumstance he must advise the sender of the freight.

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If the sender of the load wants to deliver the freight in the port of the primary assignment, he will send a written statement to the agency of the shippers on this particular matter in the port of dispatch. In such a case (if the ice situation permits it) the sending of the load is carried out by the new bill of lading on board the shipping agency or some other ship owner. In so doing the new bill of lading will provide, in addition the freight and payments that are to be made for new shipments, also the freight and other payments by the terms of the original bill of lading, and also for other expenses borne by the shipper.

In accordance with "Regulations of the Shipments by the Bill of Lading" it is not be to be qualified a breach of the contract if the deviation of the vessel from the planned course is called for by the actual necessity or the call of the vessel in the port of any sequence. In doing so the carrier does not bear any liability for the losses connected therewith. Everything that had been said above, applied to the deviations from the course or to the change of sequence of the calls in the ports in connection with the ice conditions.

On many sailing courses and overwhelming majority of the interior waterways the length of navigation is determined by the periods of ice formation and demolition of the ice covers, by the presence of the corresponding icebreaker devices and economic justification of the conduction of the vessels through the ice fields. In connection therewith for each maritime and river basin are established the periods of the reception of the loads for shipment by the corresponding agencies of the government. The time to start receiving the loads when the navigation season is open and the time for ending the obligatory reception of the freight before the closing of the navigation season, are communicated by the conventional telegrams of the Main Offices of the River and Maritime Ship Agencies, and also they are indicated in public notices exhibited in the points of dispatch and trans-shipment. In addition to this, the time periods for the start and termination of the navigation season are published in the codes of regulations of the shipments and tariffs of

the maritime and river transportations of the USSR.

After the obligatory reception period of the freight for shipment is terminated, they can be received only by agreement with the pertinent steamship agencies or by the orders of the Ministries. In so doing the steamship agencies participating in the direct water communications, are not liable before the client for the dates of delivery of the freight taken on board for shipment by the maritime and river ships and those arriving in a port of transshipment following the termination of the obligatory reception of the loads before the termination of the navigation period.

When shipping direct miscellaneous - train - waterway shipments the dates of the start and termination of the reception of the loads for transshipment, in connection with the ice conditions, should be notified 20 days before the end and beginning of navigation. This information is given by telegraph and published in the Collections of the Regulations Governing Shipments and Tariffs (of the River Transportation, Maritime and Railroad Transportation).

Besides this the pertinent main offices of communication and the offices of the postal communications of the Ministry of Communications of the USSR are issuing two decades (i.e. 20 days) ahead of the time, communications about the date of the opening and termination for the freight-carrying - passenger boats which are shipping mail items.

Section 21. Reception of the Loads for Shipment Before the Navigation Season is opened.

Depending upon the presence of the loads, the solidity

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of the ice cover and the presence of the technical means, the Ministry of the Sea Fleet, upon recommendation of the steamship agencies, makes a decision about the organization of the shipment in particular freezing areas throughout the year. It also decides on the prolongation of the navigation season in the fall or its beginning in spring.

The full year navigation in the freezing areas is not advisable at all times, but in all cases one should take measures toward utilizing, as fully as possible, the actual navigational period. From this point of view one of the essential measures is the timely reception of the loads which makes it possible to deliver them early enough to the ports and on the piers, load them up in the ships and send them to their destination with the first trips.

The loads received before the beginning of the navigation season are kept in warehouses and in the ships of the steamship agencies and ports on reduced rental basis. The order of reception of the loads from the clients in the pre-navigational period is established by the special instruction: "Regulations governing the order of delivery of the freight in the points of transshipment and drawing of the commercial documents dealing with the shipment of the freight in direct combined railroad - water communications" (see "General and Specific Rules for the Shipment of Loads, Passengers, Baggage and Goods - Baggage along Maritime Lines of Communications on Board the Vessels of the Ministry of the Merchant Marine of the USSR", the Tariff Regulations N-4, Section 1).

The periods and conditions of the reception of the loads for shipment with the preliminary winter storing in the ports of the steamship agencies are published in the collections of the rules governing the shipments and tariffs of the combined water and railroad transportation.

The steamship agencies are publishing, not later than the first of January of each year, in the newspapers the lists of transshipment ports and piers, which take the loads in storage until the beginning of navigation period and

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notify the railroad companies by wire of such accommodation. In the publications announcing the opening of points for timely reception and storage of freight, also the station or the port for such storage is indicated, including the stations for delivery of freight to the steamship agency, the beginning dates of their reception, the kinds of loads, the quantity and method of shipment (tare, loose, heaping full, etc.) and other conditions.

The steamship agencies notify the railroad companies of the termination of reception of the freight in storage (by each port or station in particular), and in case of necessity they also notify the dispatcher of the freight by wire, ten days ahead of the closing.

Section 22. The Basic Obligations and Liability of the Carrier when Transporting Passengers in the Ice Conditions.

As a rule the sailing in the ice conditions is longer than in the free water. At a prolonged sailing of the ships, especially in different climatic conditions, the administration of the ship must take care of the palliatives to offset the damaging effects of the climate. Especially when sailing in the ice-bound areas one should take measures ahead of the time to insulate the sides of the ship for warm keeping, to eliminate the excessive humidity of the aid and to maintain steady mean temperatures in the passenger quarters.

Especial attention must be devoted to the cultural accommodations of the passengers on a long trip. The vessel must be provided with a sufficient quantity of the art literature, table games, musical instruments, a selection of playing records. On board the ship the radio transmission of the latest news, concerts, etc., must be well organized.

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By devoting an overall care to the passengers during the sailing trip, the steamship agencies and the crew of the vessels are taking all measures, in order to disembark them in proper time at their points of destination. However, heavy ice conditions this is not always possible. In such cases the liability of the carrier before the passenger is regulated by the regulations in effect.

The duty of the carrier to transport the passenger to a determined port of destination, is established by the shipping regulations. In the section V of these Regulations it is stipulated that "the main office of the steamship agency, the administration of the vessels and railroad connection stations is not liable to the passengers for the delay in the departure and arrival of the ship by the schedule, and also for all the expenses and outlay of the passengers as a result of such delay". Hence the main office of the steamship agency is not liable for the passengers' stay in the hotel in the expectation of the vessel, for their board as a result of the delay in the arrival of the ship to the port of destination.

Owing to this delay in transportation the expenses for the board of the passengers and for other trip expenses, burden the carrier if they are included in the price of the fare ticket. In the latter case the steamship agency when issuing the ticket to the passenger, essentially, is making a contract with him to the delivery of same from one port to the other, with the obligation to provide him with food not for any determined period of time but for the full time of transportation from one port to another. In order to avoid such non-productive expenses the steamship agency must approach with great care, the problem of scheduling the work of the passenger ships in the fall season.

If there is a need to prolong the trip in the ice conditions, one should organize in due time the icebreaker conduction of the vessel. If for some reason not under the control of the ship, in this number and because of the ice conditions, the vessel will not call at the port appearing in the schedule, the passengers, traveling to this point,

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are disembarked in the nearest port. From there they must be taken without additional charge on board the first vessel sailing to their port of destination.

If disembarkation of passengers in the points of destination becomes impossible they again will be disembarked for the second time, in the nearest port. This time the obligations of the steamship agency as a carrier, are terminated and for their further trip the passengers must pay for their new ticket.

In the cases when the delay of the vessel draws along the interruption of the passage of the passenger (due to delay of arrival and consequent late-coming for the departure of the vessel, cooperating with the first, yet owned by another maritime line), the validity of the ticket is prolonged until the next trip.

If the vessel cannot set out for the trip scheduled by the steamship company, due to some other difficulties, the fare must be refunded to the passengers, in accordance with the Article 130 of the Code of Commercial Sea Navigation in the USSR.

CHAPTER V

PREPARATION OF THE VESSELS FOR SAILING IN THE ICE-BOUND AREAS

Section 23. Inspection and Basic Measures for Preparation of the Vessel for Sailing in the Ice Conditions.

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Before setting out for sailing in the ice-locked areas, regardless of the period of the next docking, the special docking of the vessel is very desirable, together with a careful inspection of the propellers, rudders, rudder posts, stems, rivets and seam of the outside plating.

One must check with special care the framing of the hull in the bow part. This part of the vessel is subjected to intensified efforts. Even in the free water, for instance at mooring in a stormy weather, the basic blows are taken by the cheek section, which quite frequently is conducive to the weakening of the seams and rivets of the frame. At a light bend of the frame between its external sheet and plating, a clearance is formed, and thus the solidity of the hull is weakened. In the conditions of sailing in the ice-bound areas, the danger of injury to the bow part of the hull is considerably increased, especially if the solidity of the hull had been disrupted before.

Before setting out to sea one must eliminate all the available defects, especially those which disrupt the general solidity of the hull or some specific parts of the under-water section of the vessel.

If the hull of the vessel is even free of injury, nonetheless its bow section, the stems, the rudder and plating are not sufficiently strong, they must be further reinforced. In the overwhelming number of cases this is considerably simpler and cheaper than to repair the serious damage incurred while sailing in ice. One should not forget either, that the ice injuries to the hull may be conducive to the wetting and deterioration of the cargo, and therefore, to additional heavy losses.

If the rudder installation is out of commission, even in the best case it will take a considerable loss of time, the necessity of towing, and in other cases, while navigating in complicated ice conditions - to the wintering of the ship in the ice. The hull and rudder are strengthened with additional frames, stringers, the damaged sheets are replaced, and in extreme cases they are strengthened by the welding of the double sheets.

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In order to test the watertightness of the underwater part of the ship, water is poured in various compartments, and when this is impossible, or difficult, the testing is made with the water stream from the pipe, poured under a pressure of 2 - 2.5 atmospheres.

Before setting out on a trip in ice conditions it is advisable to remove all the abutting parts of the above the surface sections of the ship. The ships frequently must be cleared of the ice by cutting it around with the aid of the icebreakers, and the abutting parts may be torn off with a part of the hull, and also cause injury to the icebreakers. If the icebreaker and the ship or two ships towed by it, are standing broadsideways and are suddenly compressed by ice the abutting parts will interfere with their separation, which again may cause serious damage.

When docking one must inspect not only the external but also the internal premises which can be reached with difficulty, and also special parts of the vessel such as holds, bunkers, tanks, the framing of the hull, the water-tight compartments, the double bottom, the bow and stern peaks, etc. One should test with especial care ~~xxxxxxx~~ previously to setting out to sea for a trip in ice conditions, the proper functioning of the water pumps, such as the water removing mechanisms, the hoses and their connections, all of which must be in perfect order.

The ships assigned for navigation in the ice conditions must have steel propellers, preferably with removable blades. As the practice of many years has demonstrated, the brass and pig iron screws get soon out of commission: the brass blades get deformed, while the cast iron blades break.

In the nonheated ballast tanks the water may, in the course of Arctic navigation, freeze. Therefore at very low temperature, from all the tanks with the exception of those disposed under the boilers and machinery, the water must be drained out; still better it would be to provide for the heating of the water tanks.

In all cases one must carefully watch that the tanks

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should not be filled to the top and the water should not come up to the water measuring pipes. If the water freezes in the tubes, it will destroy them. It is advisable to roll the tanks from time to time while water is in them.

One should check with utmost care the condition of the kingston valves. The ships built for sailing in the ice-bound areas are usually provided with a special installation, with the aid of which the kingston valves can be systematically blown through. If such an installation is not available, one should get it.

When sailing in the ice conditions one cannot recommend to use the lifeboats and working barges, as a rule, made of wood. However, quite frequently precisely such boats are used on board the icebreakers and other vessels of Arctic navigation, since they are not prohibited by the regulations of the USSR Marine Register. One should take into consideration that the frame-built barges require special care.

And the barges themselves, as well as their equipment deteriorate from sharp fluctuations of temperature. For this reason it is advisable to carefully rub through the interior of the barge so that not a drop of water remains therein and to leave the stopper open. The entire barge equipment and supplies which can be spoiled from the freeze, should be removed from the barge and stored in dry storerooms. The sails should be carefully dried, and all tarpaulin articles should be folded in and kept in bags. The cordage and tackles are placed in bights and tied with rope yarn. For each object removed from the barge a tag is provided with the proper number. The masts and oars are placed on racks.

When leaving the ice-locked area it is imperative to condition properly the lifeboats and barges in time, and to bring the barge inventory, the installations and supplies in full trim and place them so that, when the ship gets into free water, the barges will be in working condition and ready for use.

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Section 24. Provision of the Vessels Sailing in Ice Conditions.

It is equally important, before setting out into Arctic regions to check with the utmost accuracy all the food supplies, the warm clothing, fuel, lubrication and other ship supplies. These provisions must be taken from the account not only of the impending navigation, but also taking into account possible delays in the trip because of the adverse situation or some other reasons.

The quantity of the needed supplies is determined each time before the vessels set out to sea, depending upon the navigation area, time of the year, ice situation and other impending conditions. In the practice of Arctic navigation there were cases when the ships sailing out without sufficient supplies, were forced to return to their base or to call at other ports for supplementary provisions. It also happened that other vessels had to deliver fuel supplies, lubricants and food supplies to the ships which left without the necessary provisions. All this became conducive to the loss of time and exposed the ship owners to additional expense.

Supplementing the steel screws one must have a supply of removable blades, keys and other instruments, so that the blade may be replaced in case of damage or loss. If the ship must set out in the ice-bound area with brass or cast-iron propellers, one should have spare propellers (when the screw is made in one piece) or the additional blades if the screw can be dismounted. One should check ahead of the time to see, if the spare blades are fully adjustable to the stem, and if the spare stem can be adjusted to the cone of the end shaft.

On board the vessels setting out to the ice-bound areas, there must be under all circumstances a spare end shaft with a spare screw adjusted to its cone. The end shafts on the ships get out of commission far less frequently

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than the screws, however, in the experience of heavy ice navigation there were cases of the break-off of the end shaft and its loss alongside with the screw. Also there are cases on record where the end shaft and screw even in the conditions of an open roadstead and floating ice had to be replaced. Thus, for instance, the screw of the steamship "IGARKA" in the conditions of heavy drifting ice, installed after work and effort of four days, a new shaft and screw replacing the one that had been broken off and lost in operations amid the ice masses. The ship drew a powerful assistance from an icebreaker. It placed at the ship's disposal its own crane in order to deliver the shaft and screw to the place of installation, assigned its own divers and protected the ship with its own hull from the drifting ice masses.

In addition to the conventional water removing means each ship must be provided with supplementary long hoses for the pumping of the water from another vessel which had been injured by ice in the underwater portion of the hull. It is unavoidable to have also portable motor and electrical pumps of high capacity.

The portable pumps in the Arctic navigation are used not only in the cases of damage for removing the water from the injured hull of the vessel, but also for replenishing the supplies of fresh water from the snow thaw water.

Quite apart from the solidity of the hull before the ship sails in the ice-bound area, the so-called technical injury supplies must be taken on the deck for prompt repair of the damage done to the hull. In the complement of the injury supply are contained the rigid and soft plasters, cement, iron with different shapes, planks, blocks, hemp bunches, sand, and others. Besides the ordinary lifeboats the vessels assigned to Arctic navigation are provided in some cases also with the ice barges - "ice boats". These are very light barges with sleighs (runners) on the bottom. The ice barges are used for communication in the broken ice bound areas and on the ice with the shore, with other vessels, etc.

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In order to station the vessel on anchor amid the ice masses, and also in difficult cases when the icebreaker is beset, when the transfusion of water and the work of the machinery are found to be insufficient in order to free the ship, especial ice anchors with one claw are used to assist the machinery (Figure 43). Such anchors are used also during the night stops in the ice or in the case of poor visibility, when the progress of the ship is difficult. The crew of the ship takes the anchor by hand and places its claw to catch the edge of a whole cut-out in the ice. The weight of the ice anchor for its holding power is not significant, and the heavier the anchor, that much more difficult it becomes tocarry it, and for this reason the ice anchors are made either from duralumimum or aluminum, while the solidity is imparted to them by the rigidity ribs. The steel cords for the ice anchors are taken from the icebreakers with the aid of a winch or windlass.

Figure 43. The ice anchor.

The majority of the present-day icebreakers are equipped with the repair shops of the ship type, which are engaging in the locksmith, turner, auger, frazing, electro-welding and other kinds of operations of the damage-repairing type. These repair shops not only are carrying out the immediate work for the needs of the icebreaker itself, but they are also helping with the repair work on board the ships towed by the icebreaker. In addition to that, the icebreakers, as a rule, are equipped also with a diver station of the ship-carrying type.

In connection with the fact that the Arctic navigation is carried on in complicated navigational and meteorological conditions, in the absence of sparbuoys and buoys amid frequent fogs and blizzards, amidst the drifting ice masses and the like the icebreakers are equipped with the most perfect navigational instruments, such as: radio locators, gyro-compasses, echo sounds, radio direction finders, and the like.

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Of special significance in the operations of an icebreaker is the radar. During the tests made throughout the winter icebreaker campaign, it had been established that the radar is capable of showing in the most diverse conditions the various kinds of ice, even when the latter is covered with a heavy layer of snow. The straight massive ice, the drifting icebergs, the edge of the ice and the broken-up ice fields are reflected in a variety of ways on the radar screen, on which the glaciated "landscape" is depicted similarly to the elements of the coastal landscape, the lakes, the rocks, the lowlands and the passageways in the ice fields. With the aid of radar the icebreaker can tow the vessels through the most convenient and safest ways.

For the scientific investigations the icebreakers are provided with the corresponding apparatus and instruments.

Each icebreaker is supplied with reliable means of the sound, light and flag signaling, with powerful radio receivers, with the radio transmitters and radio telephone. For communications with the towed vessels, and also for the purposes of the fog signaling by sound the icebreakers are provided with powerful sirens and whistling instruments, the sounds of which are sharply distinct from the sound of the whistles and sirens of the ordinary whistles.

In case of a forced wintering or prolonged delay in the ice-bound area, some icebreakers take in the untouchable (winter) supply of food. In recent years past the ships of the Arctic navigation were supplied also with fireplaces for the heating of the premises with a view to saving fuel when the vessels' boilers are discontinued. At the present time in the wintering stations of a group of ships, on one of them the boiler is kept under steam, from which the other ships are supplied with steam for heating purposes and to derive electric energy.

In recent years quite frequently the towing is effected by powerful icebreakers of various shapes and of other floating stock not only in the ice covered areas but also in the open sea. Operating in the ice conditions while conducting

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and towing the vessels and also in the open seas when engaged in towing, the icebreakers are at the same time a powerful lifesaving ships. Therefore the icebreaker must under all circumstances be provided and supplied with all the necessary lifesaving means as well: the rocket stand or a gun for casting over of a line to the injured or towed vessel, with a supply of three inch manila cable, which will be used as a guide for the passing of the towing cable, with small anchors for getting out of the guide with an anchor attached to its end or for a lifebelt, and others.

Section 25. The Provisional Strengthening of the Hulls of Vessels for Navigation in the Ice-covered Areas.

On small seagoing and river ships with weak hulls, which have not been adjusted properly for sailing in the ice-locked areas, it is advisable to provide some temporary reinforcements of the forepeak before they set out to sea. Between the frames of the forepeak heavy wide planks are inserted. These planks are put into a rigid reinforced position with the spreaders made of cross-beams or girders, disposed in several layers. They wedge them up with special wedges and fix them to the planks by the clamps and spikes. It is quite useful to effect such a reinforcement of the bulkhead of the forepeak from the side of the Hold No. 1.

As additional temporary reinforcement of the hull on small vessels they place on the side at the distance of five to six meters from each other the "I-beams", or as they call them in a different way, the block rods. The I-beams consist of long, solid girders, which press with one end into the wooden stringers, while with the other they press ~~[illegible]~~ into some reliable reinforcement, for instance, against the hold pillars, transversal bulkheads, and others.

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On board the largest ships massive wooden girders are installed, fixed along the entire length of the hold on the internal shells of the frames. The girders are further reinforced with auxiliary wooden spreaders and are connected with each other in the way of a lock, so that along the entire length of the hold a wooden stringer is built. The internal shells of the frames should be cut into the depth of the girder, so that they should better lean on to the side. The clearances in the internal shells of the frames are hammered in with wooden padding and are firmly fixed with mast wedges.

Such a wooden stringer receives the pressure not only of the external plating but also of the frames to which it is directly attached. This reinforcement increases the rigidity of the system of the plating frame, through the virtue of its own solidity, and also through the distribution of the local pressure, which the various sectors of the plating and frame are experiencing, over the major part of the hull side.

Depending upon the size of the ship and the quantity of the decks such temporary stringers are installed on each side of the ship, singly, doubly, and (in rare cases) even three in a group, by disposing them one above the other, chiefly within the limits from the light to the freight water line.

As wooden stringers so also the "ice-beams" are in their own turn reinforced in the vertical direction by left-overs of the girders or beams, spread between the wooden supports and pillars, stringers and decks. All the wooden beams are connected with each other by heavy clamps.

Thus, on the one hand the local solidity is increased in the areas of the ship hull which are most exposed to the blows against the ice, that is, in the forepeak, hold No. 1 and in the chief part, while on the other side an additional general solidity of the whole hull is enhanced, so that it can withstand ice squeezes.

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For the protection of the plating and framing of the hull from ice injuries the metallic hull of the weak ships which have not been built for Arctic navigation, are reinforced with wooden plating in the area of the possible contact of the hull with the ice. In the bow part of the ship this plating is covered with an additional thin sheet iron or cover plate. Such a wooden plating is called "a fur coat" (Figure 44). For large, especially freight-carrying vessels it cannot be recommended and at the present time it is used but rarely.

Figure 44. Diagram of the "fur coat": 1) - "fur coat"; 2) - hold; 3) - pin welded to the side; 4) - lumber of the "fur coat"; 5) - bolt fixing the fur coat.

The above described forms of reinforcement of the hull provide the corresponding effect only for the vessels of small dimensions. However, for the ship of the medium and large tonnage it does not give any particular advantage.

For large vessels at the present time they use as additional reinforcement chiefly an additional, double frame in the forepeak and the hold No. 1. In the case of a weak hull and in the prospect of squeezing by ice the double frame is also installed in the stern or in the central, or in the rudder parts of the hull. The most effective is the installation by riveting or welding one or two reinforced side stringers in the area of the forepeak, of the hold No. 1, or even along the entire vessel in the area of the changing water line. At the large width of the spacing in the bow part of the hull, within the limits of the water line, additional frames are being inserted.

Section 26. The Peculiar Features of Loading up of the Vessels Assigned to call in the Ice-bound Areas.

The experience of sailing in the ice conditions has demonstrated that the safety of the vessel and the freight in the case of ice injuries caused to the hull depends chiefly upon the proper preparation of the hold and the corresponding size of the freight. Before loading up of the ship one should check to see whether the holds are clean, whether the measuring and air pipes are in good condition, whether the receiving grids of the water elimination pipes are cleaned, whether the shields have been placed in proper spots, and how well they are fixed with cords. The rubbish and filth that can get in such places will unfailingly clog the reception xx tubes, and as a result of this the pumping out of the incoming water is delayed or discontinued altogether.

The loading up of the vessels in the ice-covered areas and especially in the case of the Arctic navigation is marked by its specific properties. Specifically the freight loading plan must allow such a disposition of the freight in which, without a great deal of transshipment, the unloading of the freight should be carried out not by the rotation that had been assigned ahead, since the ice situation may require its distortion. It can so happen, for instance, that the first port of call is blocked with a heavy ice, while the second port is accessible. During the period of unloading or loading up of the vessel in the second port the wind may change and make the ice rather scattered in the first port as it had been provided for in the rotation of the points of call. The corresponding loading of the freight in the hold will considerably facilitate the serving of the port of call in any particular order of sequence, and will so avoid the long wait or the necessity of breaking through the ice.

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When unloading in the ports of call the thing to consider is the possibility of the taking-in of loads that are subject to export. In so doing one should take into consideration the necessity of the constant keeping of the stern in trim within the limits of two to six feet for the protection of the screw and rudder from ice-caused injuries. In the loading plan one must take into consideration, in addition, the possible and necessary change of the ballast, fresh water and liquid fuel.

The freight especially in the bow holds, must be so disposed that in the case of ice injury caused to the plating, one should promptly come to the damaged spot (usually the sides in the area of the water line). In ships with weak hulls one should leave, for this purpose, between the side and the basic mass of the loaded freight, a corridor one meter wide. On large ships one should leave at the side the tips and display them on the freight charts. These tips not only facilitate, in case of necessity, to approach the side of the vessel, but can also be used for installation of the water eliminating hose in case the hold is flooded.

When loading in the holds various types of general cargo one should not place heavy bulky loads right next to the sides; the corridors or tips that have been left should be filled with the lightest, smallest loads, which in case of necessity can be easily removed. Under such loads as coal, in the holds one should place over the frames a wooden plating so that in case of heavy or slight damage to the hull, the water could proceed freely in the places where there are receivers of the water eliminating pipes. Then the water eliminating means of the vessel will be in a position to remove the water without any handicap.

When loading the ships one should secure the corresponding height above the water line.

Based on the International Convention in regard to the loading mark, dated 1930, the USSR Maritime Register as ratified by the Central Executive Committee of the USSR,

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under the date of 17th of May 1932, has worked out the "Regulations governing the load line of the sea-going vessels". These regulations apply to the freight-carrying and passenger boats sailing abroad. In accordance with these Regulations the vessels take in a lesser load in winter than in summer, that is, in the winter season the water line must be kept higher than in summer. For the checking of the freight load on board the ship, a winter freight water line is painted on the side of the hull, marked with the letter "Z" , and in the case of vessels sailing in the Northern Atlantic, with the letters "ZSA". For the conventional vessels the winter hull side, above the water, is disposed 1/48 higher than in the case of the summer draft, and measured from the upper edge of the keel to the summer marking.

For the vessels of not over 100.5 meters long sailing in the Northern Atlantic (north of the 36th parallel), the above surface side is still further raised by 50 mm.

On board the ships assigned for the shipment of lumber, a special mark of the lumber surface side for the winter season is marked which is above the summer surface side by 1/36 of the summer draft of the vessel. The winter surface side for the vessels carrying lumber in winter, and sailing in the Northern Atlantic, is not especially computed, but is taken as equal to the customary winter surface marks for vessels sailing in the Northern Atlantic, that is, the load lines "LZSA" and "ZSA" are disposed on the same level. For the regular sailing vessels engaging in winter navigation the above surface side is not increased, and for the sailing vessels operating in the North Atlantic, the winter surface mark is 75 mm higher than the summer mark.

The sea-going vessels of the river navigation, which are given a special load line by the sea-going Register of the USSR, do not have any increased surface mark in the winter for sailing in the North Atlantic. The winter above-the-surface mark of the vessels when navigating in the internal seas is increased by 1/50th of the summer draft.

In accordance with the rules of the Seagoing Register of the USSR the ships are being loaded by the winter freight

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mark when sailing in the following areas.

Area 1. From 16th of October to 15 April - in the limits of the area of disposed inside and north of the line drawn in the southern direction from the coast of Greenland by the meridian 50° of the western longitude, by the parallel of 45° of the northern latitude; hence along the parallel of 45° of northern latitude up to the meridian 15° of western longitude; from there northward along the parallel of 60° of northern latitude, then along the 60° of northern latitude up to the western coast of Norway; at this computation Bergen is considered as located at the demarkation line between the areas Nos. 1 and 2 as indicated below.

Area 2. From the 1st of November to 31 March - when navigating in the area located outside of the area No. 1 as indicated above, and north of the parallel of 36° of northern latitude.

Area 3. From the 1st of November to 31 March - in the Baltic Sea to the parallel of the latitude of Skou.

Area 4. From the 16th of December to 15 March - in the Mediterranean and the Black Sea.

Area 5. From the 16th of October to 15 April - sailing in the northern "winter season" zone between Asia and North America, with the exception of the Sea of Japan, south of 50° of northern latitude.

Area 6. From the 1st of December to 28 (29) February - when sailing in the Sea of Japan between the parallels of 35° and 50° of northern latitude.

Area 7. From the 16th of April to 15 October - when navigating in the southern "winter season" zone.

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A port located on the boundary between the two zones, depending upon the conditions, is considered as being located inside the zone, from which the ship arrives, or within the zone, to which the ship is sailing.

Section 27. Peculiarities of Some Cargo at its Loading, Shipment and Unloading in the Winter Conditions.

When taking in the loads for shipment in the winter conditions especial attention must be devoted to the physical-chemical properties of the freight, since the subzero temperature may adversely affect many loads. Thus, the apatite ore which contains over 2% of humidity, freezes in during the loading and shipment at low temperatures. In the absence of a powerful mechanical equipment for unloading the frozen ore (the grasping cranes of great capacity) long time-consuming stay-overs of the vessel will be needed for pick-axing of the frozen mass. For this reason one should in wintertime take for shipment that kind of ore which contains less than 2% humidity.

The unloading of the apatite concentrates should be discontinued during the snowfall, since the temperature of the air in the holds and the temperature of the concentrate is somewhat higher than the temperature of the external air, which will cause the melting of the snow, and then to the freezing of the concentrate. Even though the apatite concentrates through wetting with fresh or salt water do not lose their properties and after their drying are fit for use, however, their freezing becomes conducive to difficulties at the unloading.

The kitchen and alkaline salts, the fine and humid, are so solidly frozen and glaciated under the subzero temperature that during their unloading they have to be crushed with pickaxes, special sledge hammers and even

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blasts. During the snowfall the loading of salt, as a rule, is discontinued and the holds are locked.

One should not load the milled lumber in the snowfall period if this has not already been especially provided for in the shipment agreement. The snow penetrating in the holds, thaws and the milled lumber deteriorates. In addition to this, with proper loading the milled lumber is tightly packed in the hold of the vessel. Under the effect of dampness, the planks will swell, which makes their unloading difficult, and is a liable to cause injury especially to the first rows.

In winter at the shipment of the lumber in the seasonal winter zone, the height of the deck load must not be over one-third of the greatest width of the vessel. In the winter time it is prohibited to ship heavy lumber on the deck (all manner of hewed, quadrangular lumber, the oak, beech, teak, and other kinds of lumber with greater specific gravity than that of the fir.

On deck of small ships in winter one is not permitted to ship more than five frame timbers, regardless whether they are the load or put on board as reserve for the necessities of the ship.

It is not advised to ship live stock and birds on deck in the winter season. However, if such a shipment is actually underway, one must provide for special temporary rooms with the passageways to the drain holes not less than 45 cm wide (for draining of filth, cleaning of the drain holes from the freezing of ice). The height of the location for the horses should not be less than 2.4 meters, for the bovine livestock not less than 1.9 meters, and for the small head livestock - not less than 1.0 meter. The roof is made of solid boards not less than 30 mm thick.

In accordance with the general rules, if the transportation of the livestock and birds is over 12 hours, one must have for them an average daily supply of fodder and fresh water. For the bovines and horses - one must have hay, (straw) 8 - 12 kg, and concentrated fodder 2 - 4 kg; for the

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sheep and goats - one must have hay (straw) 2 kg or 1 kg of concentrated fodder. For the hogs one should have 4 kg of grain, flour or grain fodder, for the birds 1.5 kg concentrated fodder, for 16 kg of the weight of birds being shipped. The daily supplies of water for the bovine, horses, sheep, goats and hogs are 30 liters, and for the birds - two liters. When figuring on the supplies of fodder and fresh water during navigation in ice conditions, also possible delays are taken into consideration.

Also the shipment of the perishable goods has its individual properties in the winter conditions: the dressed birds and venison, bacon, fish, animal fat and margarine, milk and dairy products, eggs, berries, fruits, vegetables, etc.

For the transportation of the perishable goods and especially for such shipment to long distances in the majority of cases refrigerator vessels are used. On board the same they maintain a steady, the most favorable temperature as may be needed for the given load.

At the shipment of perishable goods on board the customary vessels it is advisable to cover up the upper deck, the hold hatches or the deck of the twin decks, with a layer of dry sawdust, 10 - 12 cm thick, upon which a lumber cover is laid, provided it is sufficiently strong. For ventilation purposes on the bottom of the hold across the vessel the wooden cross pieces are laid with 75 mm^2 section surface.

For frozen meat the cross-pieces are laid out with an interval of 23 cm, and for other loads - with such intervals that the ends of the load be placed over the drainage pipes. Such pipes are set up vertically, along the tunnel of the propeller shaft and other vertical metallic surfaces of the hold.

The holds in which cheese is shipped must be carefully protected from cold air, since at sharp change of temperature the cheese becomes loose, is covered with cracks, and loses its fine qualities. The temperature in the hold, in which cheese is shipped, must not be below zero grade C.

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Meat in all its variations is shipped in the majority of cases in the refrigerating vessels. The cooled meat is shipped at a temperature of from 0° to 2° C +; the chilled - at a temperature from - 1° to 0° C, but not over + 1° C and at the relative humidity of the air, not below 85 - 90%; the ice-cream should be shipped at a temperature not over - 6° to - 8° C. After the loading of any meat products, it is necessary to close the holds and secure a perfect airtightness of the hatch covers.

On board the seagoing and river-going vessels frequently the fruit - vegetable loads are shipped (for instance, fruits, vegetables, gardening produce, greens, potatoes and berries). All the fruit - vegetable loads are damaged by the freezing and require a temperature of 0. to + 6° C in the holds; the berries and fruits from + 1° to + 4° C. The soft fruit - vegetable loads spoil especially fast, developing spots and signs of decay. For this reason before accepting the fruit and the vegetables for shipment, one must inspect them, open in selected places the load contents and cut through some specimens. The fruit - vegetable loads of poor quality should not be accepted for transportation. The holds must be, after the loading of the fruit and vegetables, thoroughly closed and insulated. At the transportation of the fruit - vegetable loads one must take into consideration that the goods "breathe", that is take in oxygen and release carbon-oxide gases. At the lower temperatures such exchange is slowed down, however, at a long transportation range a considerable concentration of the carbon-oxide gases can form. That is why, after opening the hatches one should not permit any human being to enter the holds in which fruit and vegetables are stored, or at least not before it is properly aired beforehand.

The eggs require for their transportation a temperature of - 1° to + 1° C, at the relative humidity of the air of 70 - 80%. The temperature below - 1° C is not permissible, and if at the time of loading during the sailing run or in the port of assignment the temperature was below - 1° C, the eggs are received for shipment only in the refrigerated holds. The other egg loads (dry and liquid egg albumen, the dry eggs, the egg dust) are shipped at the temperature within

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the limits of $- 9.5^{\circ}$ to $- 12^{\circ}$ C, and are received for transportation in a solidly frozen condition.

The fish and the fish products, in this group also cooled (in the barrels, boxes or baskets) and the frozen ones, as well as granulated caviar packed in the oak barrels or metal barrels, is shipped in the majority of cases in the holds of non-refrigerated vessels with a fine crushed ice.

The drinks in bottles, larger containers or barrels (with the exception of alcohol and beer in barrels) are not accepted for shipment at low subzero tempatures in the conventional dry load ships.

The sugar is intensely hydroscopic, and for this reason it cannot be loaded during snowfall: if the snow falls, loading or unloading of sugar must be stopped and the holds tightly closed.

The liquid loads become at the low temperature very thick. When transporting such loads by pouring in some of them may even clog the pipe channels of the transfusion system. For this reason the holds of the tankers, sailing in the conditions of the freezing temperatures, are usually equipped with the heating installations in the form of coils disposed in the lower or upper part of the tank. In those cases when the oil has a low temperature of cooling, the coils are usually not installed, but steam is let in the double bottomed tanks disposed under the deep tanks. To the number of loads which frequently are shipped by pumping, belong the vegetable fats and oils. The former ones thicken already at temperatures of + 15 C, while the others at lower temperatures; thus the castor oil thickens at a temperature of $- 16.7^{\circ}$ to $- 17.8^{\circ}$ C, the hemp oil (olive) thickens at $- 8.5^{\circ}$ to $- 15^{\circ}$ C, the olive oil from $- 1.1^{\circ}$ to $- 5^{\circ}$ C, soya oil at the temperature of $- 11.9^{\circ}$ C, etc.

We should keep in mind that one can heat oils only to a certain limit, beyond which they lose their color and properties. This is the reason why in every single case one

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must receive the instructions concerning the temperature needed for a reliable ship of oil before the loading of same, and the permissible heating of the oils should be ascertained.

Cocoa oil thickens, depending upon its quality, and is made solid at a temperature of + 15° to + 21° C. For this reason the cocoa oil which got in the hold section must not be pumped off; it will freeze in the pipes and for their cleaning the pipes must be fully taken apart. The cocoa oil and molasses can be shipped in the tankers by pumping with obligatory heating of same up to +29° to 30° C.

Cement is one of the hydroscopic loads, which under the effect of dampness will lose its viscuous properties and will turn into a solid mass. That is why the loading and unloading of cement should not be carried out during a snowfall or rainfall.

Especially complicated in winter season is the transportation, loading and unloading of the oil products. During the loading of the tar - oil products, one must put out the fire on board the ship, and moor the vessel on the pier. The heating of the focal points is permitted only when all the hold hatches have been tightly closed. If the vessel transports the first-class oil products the camboose can be used only when the vessel is at sea.

At transportation of oil products by pumping one must take into consideration that with the lowering of the temperature, their viscosity is increasing. The temperature of freezing of the oil products depends upon the contents of paraffin. The oil products lacking paraffin or having such a in small quantity, have temperature of their thickening below zero, while those containing paraffin have it above zero.

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CHAPTER VI

RULES AND SIGNALS FOR THE VESSELS IN THE ARCTIC NAVIGATION

Section 28. Rules for Vessels Towed in the Ice.

The captain of the vessel proceeding in the ice channel under the conduction of the icebreaker, must go strictly by the special regulations published in the "Notices to Mariners" and "Sailing Directions" for the freezing seas of the USSR. These rules are obligatory for vessels sailing under the Soviet flag, as well as under foreign flags.

In accordance with the regulations the request for the convoying of the vessel through the ice is submitted in the port to the chief of the port, and at sea to the captain of the icebreaker. The ship requiring the assistance of the icebreaker must be provided with sufficient supplies of coal, sufficient to last through the towing progress, as well as with food supplies, wooden cross pieces, a quick action cement, plaster, mats and the like. The water pumping means of the vessel and the radio installation must be in good working order. In addition, the vessel must have certificates issued in the legal manner, and not over the granted period, by the government authorities or the classifying societies concerning the seaworthiness of the ship in the ice conditions. In the absence of the needed supplies and the requisite cred/entials, the chief of the port, and outside of the port area, the captain of the icebreaker has the authority to deny the vessel's request to take it to sea or to convey it to the port.

The captain of the ship in need of convoying through ice-covered areas, upon accepting the services of the icebreaker, by this very fact expresses, eo ipso, his agreement

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to comply with the "Regulations for the Vessels Conducted Through the Ice". Each vessel in need of convoying through the ice, must wait for the arrival of the icebreaker and not to get into the ice of its own accord. The time and order of sequence of the vessels through the ice, and also the number of the ships simultaneously convoyed, is determined in the port by the chief of the port, while at sea it is determined by the captain of the icebreaker.

The captains of the ships conducted through the ice, must carry out all the orders of the captain of the ice-breaker. The vessels following the icebreakers are not authorized to bypass one another, or give their machine plant run forward action without the especial order of the captain of the icebreaker. They must at all times be prepared to give full power forward or backward by the order of the captain of the icebreaker, or drop the towing cable.

First of all the icebreakers tow the vessels of the mail-carrying - passenger steamers and the ships with such cargo, with reference to which the government agency or the steamship agency gave especial preference, and after that the other vessels are taken on in the order of their arrival to the edge of the ice or to their readiness to leave the port.

The vessels following the icebreaker, are guided by the signals issued with whistles or sirens. In case of ship damage, the captain of the vessels towed by the icebreaker must immediately issue the distress signal, in accordance with the International Code of Signals.

If the captain of the vessel does not carry out the orders of the captain of the icebreaker, the latter is authorized to deny it further assistance up to complete execution of the order.

It is provided by the regulations that neither the ice-breaker nor the owner, nor the freight owner have any financial liability for the injuries and other losses which may be caused to the towed vessel during the time and in consequence of the conduction through the ice and maneuvers connected with it.

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The freighters of all flags usually have the services of the icebreakers of the corresponding ports, free of charge for towing from the edge of the ice to the port, or from the port to the sea, for conduction of same within the limits of the port waters, and also for towing during the time of conduction, if this towing has been judged necessary by the captain of the icebreaker. The remooring of the vessels for the loading - unloading operations, coaling, docking, etc., is carried out for the proper fee.

Section 29. Signals Used During the Convoying Period of the Vessels in their Passage Through the Ice.

During the convoying of the vessels by the icebreakers into the sea ports, the sound signals are used as established by the Article II of the "Regulations for the Vessels Conducted Through the Ice (Table 6). All the signals with the exception of signal 6, must be repeated by the vessels following the icebreaker in their order of sequence, beginning from the vessel nearest to the icebreaker or to the ship issuing the signal. The demands of the icebreakers communicated by their signals must be promptly executed by the ships.

When the ships are passing each other in the ice the sound signals are used which are specified in the regulations for avoiding collision of the vessels at sea (PPSS): one short blow - "I am proceeding to the right", two short blows, - "I am proceeding to the left", - three short blows meaning "the engines are working on their rear run".

The markings of the signals in the Table 6 correspond to the signals accepted in the Regulations of the "International Code of Signals" and the "Regulations for Avoiding

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Collisons of the Ships at Sea" (PPSS); the line standing for a long sound, and the dots - for the short sounds; the length of the long sound being that from four to six seconds, and the short sound - one second.

At the simultaneous operations of several icebreakers the senior is considered the one, whose engine plant is more powerful and its dispositions must be carried out by the other icebreakers (in case there is no other disposition of the port chief.

In addition to the general rules mentioned above, periodically, depending upon the conditions of sailing in ice, temporary rules are issued for some specific basin.

When conducting the vessels in the ice area during a foggy, misty, sector, during the snowfall, sound signals are used as prescribed in the Article 15 of PPSS (Regulations for Avoiding Collisions of Vessels at Sea). The steamships in full run issue the signals with their steam whistles or electrical whistles, by steam or pneumatic sirens; the sailing vessels - by the special fog horns; all the ships standing at anchor - both the steamships and the sailing vessels - with a bell (in a foggy weather it should not be less often than every minute for five seconds).

Each vessel equipped with a mechanical motor, while on its sailing course, will give over equal time intervals, not over two minutes, one long sound. The vessel equipped with a mechanical motor, while in its sailing course but temporarily stopping the machine plant, must emit two long sounds with sirens in the intervals of 1 - 1-1/2 or at least two minutes.

The ship equipped with a mechanical motor, which cannot bypass another ship because of the maneuvering difficulties, must issue systematically, in the intervals of one to two minutes, one long and two short sounds with its steam whistle or siren.

TABLE 6

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TABLE 6

No. Sig.	Signal marks	Meaning of the given signal	
		From leading icebreaker	From the vessel
1	- - .	I am proceeding forward, follow me.	I am going forward, I follow the icebreaker.
2	- .	Reduce your sailing speed.	I am reducing my sailing speed.
3	. . .	Give full course backward.	I am giving full course backward.
4	- -	Do not follow me, stop!	I am stopping.
5	. . . . .	I got stuck in the ice, attention!	It got stuck in the ice, attention.
6	- . -	Be ready to take on the towing cable or (if the vessel follows the icebreaker untow). Drop the towing cable.	I am ready to take on the towing cable. I am dropping the towing cable.
7	- . - .	Proceed forward, follow through the channel.	I am sailing forward, I follow through the channel.
8	. - - -	Reduce the interval	I am reducing the interval.
9	- - -	Follow according to assignment.	I am following according to assignment.
10	. - .	Listen to the radio.	I am listening to the radio.
11	- . . -	Attention, follow the signals.	Attention, I am following the signals.

/Contd/

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TABLE 6 - contd.

No. Sig.	Signal marks	Meaning of the given signal: From leading icebreaker	From the vessel.
12	. - - .	Drop the anchor	I am anchoring.
13.	-----	The operations will be discontinued until the next spring when more favorable conditions are expected. (If the operations have been discontinued until the resumption of operations). Get ready.	I am carrying out the orders.

The vessels in tow are permitted to issue the signal with horn, and in addition to this signal, they do not have to give any other sound signals.

The shorter the distance between the icebreaker and the conducted vessel, that much more successful will be the conduction, for the channel made by the icebreaker does not have time to fill up with ice. However, due to the uneven solidity of the ice the icebreaker may suddenly increase or reduce its own speed, and if the vessel following it does not react to the signal with the proper dispatch, then it may either get stuck in the ice, or collide with the icebreaker. For this reason each ship captain must know well the signals. On the commander's bridge and in the pilothouse one should exhibit the signal tables, written out with white paint on a black background.

At low temperatures, during the fog periods, powerful winds, snowfalls, the steam whistles and sirens are not quite reliable, and before issuing the signals, they must

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be thoroughly blown through. The ships proceeding from the lee side or at a considerable distance, can mistake the blowing through of the steam for a signal. In such cases, or when the signals given by the ship whistle, are not heard because of the strong wind, of the adverse direction of the wind, or because of the long intervals between the vessels, in place of the sound signals the flag signals or the figures are used.

The ball or the flag raised to its proper place means: "I am proceeding forward, follow me"; the ball or the flag raised to half its height, means: "Reduce the sailing speed"; removal of the ball or flag - "Stop where you are, do not follow me". All the other signals are transmitted by radio or by the flag semaphore.

At night time the signaling is usually carried out by blinker signal light or by searchlight. Due to its great light power the searchlight may be used for the transmission of signals not only at night but also in day-time. With the searchlight with a long distance range one can transmit or receive signals at a distance of 30 miles or more. At night, while the clouds are high up, the searchlight beam, directed at the sky by its reflection can be seen at a distance of 40 miles or more. In general, the searchlight beam directed vertically upward, can be seen at a greater distance than when being directed at the observer himself.

To use the signal searchlight for the transmission of signals at a short distance is not advisable, since a strong beam blindens the attendant on the receiving end.

Section 30. Signals about the Ice Conditions.

For the proper organization of the traffic of the steamship fleet, the ports and the ship captains must know in proper time about the appearance, condition and shift of the ice masses in the freezing sea. Therefore in such

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sens the weather service is organized, which in the ice period of the year is making continuous, uninterrupted observations of the movement of the ice masses, is drawing ice charts, and is making up the surveys and prognostications. All these materials are published in special daily bulletins. On the masts of lighthouses or in the ports, signals are raised indicating appearance of the ice.

In every country its own system of ice signaling is established, and by these signals the ships are informed of the appearance and nature of the ice. In the light parts of the day on top of the signaling stations, they raise balls, cones, cylinders, etc., and at night time they raise red, white or green lights. Sometimes for the purpose of issuing ice signals they change the color of the beacon, for instance a red light is replaced by a white light, or inversely.

On all the conventional ice signals a report is issued, in proper time, in the "Notices to Mariners" and the corresponding "Sailing Directions".

Information about the ice is passed on by coded radiograms, by means of ten figures, divided into two groups of five figures each. The figures are preceded by the word "ICE", which means "Ice Radiograms". The ice radiograms are coded with three codes.

By code No. I with two figures from 01 to 31 the date of the month is transmitted.

By code No. II the time of observation bearing on the ice set-up is transmitted each subsequent three hours, in the form of the conventional figure corresponding to this period.

The hour of observation from 1 to 4 hours is marked by the figure 1.

The hour of observation from 4 to 7 hours is marked by the figure 2.

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The hour of observation from 7 to 10 hours is marked by the figure 3.

The hour of observation from 10 to 13 hours is marked by the figure 4.

The hour of observation from 13 - 16 hours is marked by the figure 5.

The hour of observation from 16 to 19 hours is marked by the figure 6.

The hour of observation from 19 to 22 hours is marked by the figure 7.

The hour of observation from 22 to 1 hours is marked by the figure 8.

By code III the nature of the observed ice masses and floating objects is transmitted, that is, the navigational characteristics of the ice.

0 means there is no ice.

1 means one iceberg, a large mass of the floating ice.

2 means several icebergs.

3 means many icebergs.

4 means a large mass of the freezing salt water, having the appearance of small icebergs.

5 means ice fields; the ice masses spreading ice to the limits of visibility, but through which one can sail.

6 means debris of the partially frozen icebergs or ice fields.

7 means ice masses which keep staying near the shore since the last winter.

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8 means floating ice masses.

9 means crushed ice.

The last three figures of the ice radiogram denotes the longitude of the place up to tenths of a degree.

Let us decode the following ice radiogram: Ice 17435 59267. The first two figures, in accordance with the code No. 1 denotes the date of the month, that is, the 17th. The next figure, in accordance with the Code No. II, denotes the hour of observation; the figure 4 indicates that the observation had been carried out from 10 to 13 hours. The fourth figure denotes nature of the observed ice masses: three in accordance with code No. III means "many icebergs". The fifth figure of the first group and the first two figures in the second group indicate the latitude in degrees in 10ths of a degree. In said example - 55.9° (55°54'). The last three figures of the second group denote the longitude of the place, that is, 26.7° (26°42').

Consequently, the coded telegram has the full open meaning: "On the 17th of the month between 10 and 13 hours at the latitude of 55°54' and longitude 26°42' many icebergs have been discovered".

Section 31. The International Convention on the Search, Observation and Study of the Ice Masses.

On the 31st of May 1929 twenty maritime states signed in London an International Convention for Preservation of the Human Life at Sea, which is effective to the present time. With the articles 36, 37, 38 and 39 of this Convention the obligation has been entered into by 14 states who keep a

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special survey in the North Atlantic for the search of the ice masses, study their condition and the observation of ice movements (see attachment 3). The ice service has been placed directly on the conveniences of the United States Government, while the contracting party will participate in contributions to the cost of this service.

The ice service is also under obligation to take measures toward destruction or elimination of the floating objects in the northern part of the Atlantic Ocean, east of the line passing from Cape Pesochny to the cross-section point of 34° of northern latitude and 270° of western longitude, if it is necessary to secure the safety of sea navigation.

The contracting governments took upon themselves the obligation to engage for ice service not more than three vessels. Throughout the entire ice season these vessels will investigate the southeastern, southern and southwestern edges of the iceberg areas, in the neighborhood with the large Newfoundland Bank, for warning the transatlantic and other vessels about the size of the dangerous areas, they observe and study the conditions of the ice masses and give assistance to the ships in distress. In the rest of the year the observation on the conditions of the ice masses is carried out only within the limits of necessity, but one ship is always in full readiness for the search. On Figure 45 we see the picture of the International Ice Patrol "OVASKO".

Figure 45. The vessel of the International Ice Patrol "OVASKO".

If on the trip or not far from the course pursued by the vessel ice masses are detected, it must throughout the night proceed with reduced speed, or change its course in such a way as to be at a distance from the danger zone. The selection of the way and the initiative in taking the necessary measures of safety, charge the liability of the interested steamship lines, and practically they charge the captain with liability.

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The governments participating in the Convention must give the steamship lines and directly the captains of the vessels full assistance, by placing at their disposition, upon special requests, all the available data on the courses.

In addition to this, all these governments must promulgate for publication information all those customary courses by which they advise the ships to proceed, and also all the changes detected by the captains on these courses. The governments participating in the Convention, must also impress the charterers of the vessels crossing the Atlantic, that they should proceed, so far as the circumstances permit, by the well established routes. The vessels crossing the Atlantic and sailing in the direction of the ports or from the ports of the United States of America, and passing near the Newfoundland Banks should, so far as possible, bypass in the fish hatching season the fisherie banks of Newfoundland to the North from the 43° of the northern latitude and up, and keep to the course outside of the areas known for ice hazards. On Figure 46 the diagram chart of the drift of icebergs is presented bearing on the North Atlantic.

Figure 46. Diagram chart of the drift of icebergs in the North Atlantic.

/Top, center - Glacier ice. /Below, - Greenland.
/Left - Baffinland. /Below - Hudson Bay.
/Right - Hudson Strait. /Right - West Greenland current.
/Left - Laborador current. /Left - Laborador.
/Right - Greenland - Eastern Greenland Current.
/Right - Iceland. /Below - Irminger current.
/Below - Atlantic current. /Left - Newfoundland.
/Left - St. Lawrence Bay. /Below - Gulf Stream.

The administration, in the disposition of which the service for the search of the ice masses is engaged, will notify the interested administration about every ship noticed away from the customary or specially announced course, and also of the ships which, sailing in the ports or from the

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ports of the United States of America, are plying over the areas fraught with considerable ice hazards. Each ship captain sailing through the northern part of the Atlantic Ocean, must, in order to avoid collision with the floating icebergs, get all the precise information on the safe routes and follow closely all the notices on the ice conditions in the area of his navigation progress. Besides this, regardless of the notices obtained during the sailing period, he must set up a very careful observation of the horizon.

CHAPTER VII

CONDITIONS OF THE PASSAGE OF THE SHIPS IN THE ICE-LOCKED AREAS

Section 32. The Basic Conditions for the Passage of the Ships in the Iced Surfaces.

Passage of the ship among the ice masses depends upon the ball characteristics, solidity and the thickness of the ice cover, upon the conditions of navigation, upon the construction and technical condition of the vessel, and also upon the qualifications, discipline and watchfulness of the crew.

It is not recommended to have maladjusted ships sail among the ice masses of any ball evaluation, since the ice as a rule, is constantly moving and quite frequently in a few hours, in special portions of the tract, it can thicken to such an extent that the vessel will be crushed or contract ice injuries or be dragged by a drift to a shoal, whither the icebreaker, by its draft, cannot come close to

offer assistance.

As far as the conditions of the passage of the ships in the extensive immobilized ice fields is concerned, so unfortunately, up to the present time there is not a single flawless criterion determining the thickness and solidity of the ice masses which can be overcome by the same, or some other ship. At one and the same thickness and the ball characteristics of the ice, its solidity fluctuates within wide limits. For this reason, if it is known, that a certain vessel had overcome a ten-ball ice with a thickness of say, 30 cm and another ship in the same area, but at a different time had overcome a 30 cm thick ice, one cannot draw the conclusion that the first ship had a better passage virtue in the ice conditions. In the first case the ice could have been considerably weaker than in the second one. Up to this time there is not a single unit for the measuring of the quality of the ice. One has also to note that various authors suggest a variety of factors, being effective in the increase of the ship's capacity to break through the ice.

The sailing conditions while navigating among the ice masses are also much more difficult than while sailing in the conditions of the free water. The ice cuts down the sparbuoys, removes the buoys and one can determine the location of the ship only by the shore beacons and landmarks. The daylight time is limited. At night the movement of the ship in the ice is made difficult since the light of the searchlights considerably distorts the idea of the nature of the ice masses. But even the anchoring in the ice through the night is not always possible or advisable. By the currents and the drifts of the ice the ship can be easily pushed on the sand.

For orientation of the six-ball scale is used, bearing on the passage capacity of the usual shipping vessels proceeding independently or of the icebreakers leading caravans of ships in a floating ice.[1)]

Footnote 1: This scale should not be used with the scale of the ball evaluation of the ice.

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Conditions of Sailing in the Ice.

The passage ball system	
0	The ship proceeds in free water or in water next to being free.
1	The ship sailing in the ice, changes but slightly its course and easily bypasses the large masses of ice.
2	The ship sails by dodging the ice masses, and is occasionally changing the speed of its course.
3	The ship sails by intensely dodging the ice masses, by changing its course from the forward to "stop" and to the rear movement; it breaks through the ice banks.
4	The ship sails in the ice, almost abandoning the charted course, by changing its speed, breaks through the ice by onrush and proceeds very slowly.
5	The ship moves through the ice by jolts, its progress is measured by the distances equal to the length of the hull.
6.	The ship is not in a position to move forward.

One in the same ball of passage capacity through the ice masses depends in the case of each vessel upon the power of its machinery, construction and technical condition of the hull and the surrounding conditions. Thus, for instance, if the shipping vessel with a machine capacity of 1,000 hp and a hull not adjusted to sailing in the ice, is not in a position to proceed through ice cover 40 cm thick, so the heavy-duty icebreaker in the same ice conditions can proceed without stop, and without changing its course. If at good

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visibility the ship with the relatively weak hull can sail at full speed, dodging the ice masses, changing its course only now and then as it makes sharp turns, then at a time of fog, dense snowfall, in the absence of a sufficient visibility, or in the worst case, depending upon the condition the same ship must stop to wait until vision clears, or at least, depending upon the conditions, move forward only at a slow speed, taking at the same time all the measures of precaution.

Practically any shipping vessel in a satisfactory technical condition, in favorable sailing conditions, can navigate independently in the weakened ice masses of up to five - six balls.

However, one must take into consideration that in many cases the rarified (weakened) ice from three to six balls, is not uniformly spread out in the area of the ship's course. Frequently one comes across the accumulation (condensation) of the ice making the passage of the ship very difficult.

In the practice of ice navigation many cases are on record, when in between six and seven ball ice there were condensations of eight to nine balls both of large and crushed ice. In order to get out into the area of the rarified ice located a short distance, the ships had to proceed with utmost caution, pushing aside the accumulation of the ice masses.

The captains of the ships do their best to bypass such accumulations of ice masses, selecting more manageable passages between the icebergs. As a matter of course this is quite a good principle, however, one should not abuse the bypassing of the heavy ice groups without perfect knowledge of the fact that in the other direction the ice is more passable. Cases are on record when without an ice chart or proper information, the captains of vessels, in their effort to bypass the heavy ice masses, have deviated considerably from the course and got into still more difficult ice conditions. In order to get out such vessels the aid of the icebreaker was needed. Especially difficult, and frequently

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unsuccessful bypassing is the bypassing in the conditions of poor visibility or in the dense fog.

Large ships, however weak by their construction, may sail in the ice conditions of five balls, yet not without risk. The navigation in the heavy ice situation by the vessels not adjusted for that purpose, and as a rule, meeting with injuries, and sometimes with the doom of the vessel is not permitted by the Sea Register of the USSR and the other classifying institutions.

In the ice conditions of up to six balls the vessels of the medium tonnage can sail, however, being properly outfitted and in good technical condition. The freight carriers of the Arctic class can sail also in the ice areas of up to seven ball strength. This, of course, does not mean that the ice sailing ~~xxx~~ class vessels does not have any chance to sail in an eight ball heavy ice, and that it is not at all adjusted for sailing in the ice conditions, and further blighted with the technical defects, cannot find its way through the ice masses of six balls. However, such a navigation will be most ineffective and, as a rule, will end in damage caused by the ice.

In addition to the ball scale of the ice, we have to take into consideration also its thickness and solidity. For the weak and thin ice the above indicated limits of the ball scale can be increased by one to two balls, and in the case of heavy solid ice, on the contrary, it has to be reduced by just about that much. Powerful enduring winds will force the ice fields into shifting, they heap them up one above the other, and are building up an unsurmountable obstacle or one that can be overcome with great difficulty, not only by the freight-carrying vessels, but also by the icebreakers. In the Polar Seas such accumulations of ice reach quite frequently the height of three to four meters, and sometimes of ten to fifteen meters above the sealevel.

For the present-day icebreakers and ships fitted for Arctic navigation that ice is considered impassable, which appears in the condition of a powerful compression under the effects of long and powerful winds, and also under

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the effect of the tides and other currents. If the wind and current operate from the edge of the ice into the open sea, then the ice is diluted. If, on the contrary, the wind and current operate against the edge of the ice cover, then the ice will be in the condition of compression. In the ice masses which are compressed, the progress of the vessel is extremely difficult or even impossible. On the other hand, in the ice tracts that are rarified the navigation is possible in all the cases when the power of the vessel is sufficient to break open these ice covers.

The snow cover, which is stratified on the top of the ice surface, may frequently reach a considerable height, mixed with the crushed ice and so forms a resilient cushion, which slows down considerably, and sometimes may even stop the movement of the vessel. The wet snow acts upon the course of the vessel as a sharp brake, due to the fact that it sticks to the sides of the hull. The large masses of sludge or fine crushed ice, mixed with the snow both at sea and in the rivers, are not passable for the vessels even adjusted for navigation in the ice conditions, and also for powerful icebreakers which are not equipped with the bow propellers.

Impassable for vessels of all classes are considered the drifting fields of large-size which move with such a speed and force, that a vessel with even a powerful machine plant and strong hull cannot contend with it and is dragged into the drift, in which case it frequently gets on a sand-bank or is stuck against the cliffs.

Section 33. The Passing Capacity of the Vessels in the Ice Conditions Depending upon the Shape of the Hull, on the Equipment to Produce Great Energy and Upon Other Factors.

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The most important factors instrumental in the passage capacity of a vessel in the ice conditions, are the sh shape of its hull and the power of its machinery. It has been stated above that the operation of a vessel adjusted for destruction of the ice cover, may be based on two principles: it can either work as a wedge, that is, break open and shove on the side with its hull the ice obstacle, or, by climbing on the top of the ice cover, break it through by its own weight.

IN THE FIRST CASE the ship breaks a channel for its own progress in the ice conditions, by preserving the normally horizontal position of its water line, that is, without changing its trim. Every freight-carrying vessel acts in the same way, when it sails in the wake of an ice-breaker. For this operation the bow part of the vessel must be narrowed down toward the stem and stretched out in front so that it could enter the ice field with a wedge. In so doing the wider is the hull of the vessel, that much greater must be the power of its machinery. The shape of the ship propellers must be figured for a great pressure at the relatively small maximum speed. The narrower is the bow section of the wedge-shaped ship, that much easier it will overcome the ice at the same power of the machinery.

The ship operating as a wedge, can successfully proceed only among the floating ice masses with wide cracks and channels. Such conditions frequently appear in spring and in fall, and in the high latitudes also in summer, when the ice under the effect of winds is pushed apart and forms free channels. Whatever the thickness of the ice or depth of the accumulation of the ice masses, if in the area of the ship operation with a fairly powerful wedge-shaped construction, it will force its way through the puddles, free water or very weak ice cover.

In the ice navigation the vessel must operate in varying conditions, beginning with the easiest ones, at which it is confronted with insignificant resistance of the ice, and up to such ones that wedge the force of the pressure of the vessel against the ice is equalized with the resistance force of the ice. In such a case the ship will stop dead.

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If a wedge-shaped vessel cannot destroy the ice and move apart the ice during a normal progression, it has still another effort in reserve. The ship moves backward, develops high speed and strikes against the ice with its stem. At this operation the force of the vessel's action increases by the magnitude of the speed of its movement at the time of the blow. Such a maneuver is resorted to in the practice of the Arctic navigation quite frequently.

IN THE SECOND CASE the ship with a truncated shape of its bow section, climbs on top the ice surface and breaks it through with its own weight. In this case the ice reacts as a flat platform with a contour up to the moment of its destruction supported in endless quantity of points by the water, that is, being located on a resilient foundation which will considerably increase the resistance of the ice to breakage and permit it to hold considerable weights.

Under the effect of the horizontal effort of the propellers the ship will keep climbing with its slanting bow parts on top the ice, until the moment when it will be stopped by the force of resistance. The greater is the angle of slant of the bow part of the vessel, that much less is the vertical effort, and the more the delineation of the bow part of the vessel is above the horizontal, that much greater is its breaking effort. But the trouble is that the selection of the most advantageous configuration of the bow part of the icebreaker depends not only upon the necessity of getting the greatest breaking momentum, but also upon a whole series of constructive considerations. In particular, one must preserve a sufficent stability of the ship, dispose on its board the power plant of great force and provide sufficient supplies of fuel, and on board the freighters also the loads.

Usually in the case of the icebreakers and other ships of the active Arctic navigation the angle of slant of the stem and the central angle of slant of the lower part of the buttocks to the horizon is in the neighborhood of 18° to 40°.

In addition to the shape of the hull of extreme

importance, during the operation of the vessel in the ice condition, is the friction factor of the ice against the metal, from which the ship has been made. The value of this factor varies and depends upon the temperature of the air and ice, quality of the ice, thickness of the snow cover, of the condition of the surface of the bow part of the vessel and upon some other factors. As the ship sets out to operate in the ice conditions, while its hull is covered with paint, the resistance is somewhat greater; but when the paint is rubbed off from the hull, the friction of the vessel against the ice is reduced.

The greater is the equipment of the ship with energy, that is, the relation of the power to the water displacement, that much more efficiently it will operate in the ice. The ~~Ship Protecting Bureau of the Arctic Projects, by the sug-~~ gestion and under strict supervision of the captain of long range navigation, B. E. Shishov, a new roadstead icebreaker towing diesel boat RBT (Figure 47) has been constructed. The length of the ship is 14 meters, its width is 3.6 meters; two 150 hp motors are installed on board the ship. The relation of the power of the vessel to its displacement is about 6 : 1. This makes it possible for the ship to operate successfully in fairly solid ice covers up to 30 cm thick. Serial construction of such ships has been effected on one of the plants of the Ministry of the Merchant Marine. In January 1954 the ship "RBT-44" arrived in Moscow from Kuybyshev; passing hundreds of kilometers in the ice, it successfully overcame in the Kama Estuary the ice cover 20 cm thick.

Figure 47. Roadstead ice-breaking - towing motorboat "RBT".

There is no doubt that in the nearest future also large icebreakers will be built with similar correlation of the power to the displacement, which will considerably increase the efficiency of the struggle with the ice conditions with the aid of the icebreakers.

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The build-up of the vertical effort sufficient for the purpose to overcome the resistance of the ice, depends chiefly upon the force of the machinery, the energy of the propellers, of the angle of slant and the weight of the bow part of the vessel breaking the ice, and also upon the displacement. These basic elements are the characteristic features of a vessel for active navigation in the ice conditions. The separate cycles of its work, that is, the raising of the bow part, its climbing on the top of the ice, its dropping due to the breakage of the ice when navigating in the relatively weak ice appear in an uninterrupted series of sequence. The more solid is the ice, that much more definitely and sharply these cycles are dismembered. Thus, the vessel destroying the ice cover by a vertical effort, operates normally in a brittle continuous extensive smooth ice field. The actual designing of the vessel is aiming precisely at such conditions: the ice of an increased viscosity, the fine ice, the snow covered ice, and the ice embankment.

A ship of this construction will break through and shove on the side the ice of increased viscosity, the ice grits, the snow-covered ice and the ice embankments until it is stopped by friction. In this operation the ice acquires a semblance of elasticity and the ship gets stuck.

If the broken-up ice is seated deep and moves with difficulty in the opposite sides, the ship will climb upon same as upon a floating ice cushion, which being under the bow part of the hull of the ship, moves forward and sinks by slightly raising the ship. Quite naturally this trimming is slighter than when the bow of the ship climbs on the ice cover, which will hold the vessel. By crawling upon the "ice cushion" the ship will not leave any channel behind, since at its movement ~~xxxx~~ forward the ice rises again and fills the space freed by the hull of the ship. To descend with the aid of its own power plant from the "ice cushion" is not always possible for the ship, since at its rise on the top of the ice quite considerable resistances take place. In connection with this quite frequently the ballast should be shifted and/or, if there is a large ice field, cast ice anchors, or, finally, ask another ship to take it on tow.

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Consequently, the wedge-shaped ship of the active Arctic navigation is more successfully adjusted for operations in the ice grits and amid the ice holes; the ship breaking the ice by its own weight is more efficient in the brittle flat ice fields. Even though both types of ships are utilized for the same purpose, the principle of their operations is different. If the conditions of work in the ice, even within the limits of one single sea or basin, would be homogeneous, one could select for this particular area the most advantageous type of ship, but, unfortunately, this is impossible, since in any area the ship may come across both the brittle and grit-like ice, continuing ice and with ice holes, with ice embankments as well as in the form of a level flat ice field.

For this reason for the purposes of Arctic navigation one should build such vessels in which both ice-forcing principles are combined - these ships must operate with the greatest success both in the grit-like ice as in the brittle ice.

The correct icebreaking form of the formation of the bow section, in combination with a solid hull, a powerful machinery and solid rudder frames, vanes and rod of the rudder, the propeller - these are the basic conditions of a successful work of the ship in the ice conditions.

Section 34. The Sailing Speed of Vessels When Navigating in Ice Conditions.

The ice situation under the effect of wind, currents and temperature changes fairly rapidly. There where the condition of the ice permits the ship to pass to the point of her call without difficulty, there the next day may arise an ice barrier impossible to overcome. In the case of carrier ships not authorized for navigation in the Arctic and by their construction not set for sailing in the ice,

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each powerful impact against an ice block may cause injury. Therefore the speed of such vessels must be small. The closer the shape of the hull side to the front part of the ship, to the so-called "icebreaking form", that much faster the ship can sail in the ice.

The speed with which the ship can proceed in ice, depends also upon other causes. For instance, the greater is the inertia developed by the ship, that much lesser should be its speed, since for the stopping in front of heavy ice, which cannot be bypassed, there is a need for relatively much time. At a great draft and especially at the trim for the underbow the majority of the freight-carriers with freight (close to the vertical) formation of the stem, receives a direct impact when confronted with ice, since it does not climb on the top of the ice surface as is done by the icebreakers or the ships of the class fitted for sailing in the ice conditions. Therefore the deeper the draft in the case of a freighter and the closer the trim to the bow, that much lesser should be its speed when sailing in the ice conditions. At a heavy trim at the stern, on the contrary, the speed can be increased. However, the trim on the stern should not be excessive.

The experience has shown, too heavy a trim on the stern, in vessels carrying ballast, during the time of the ice conduction, interferes seriously with their steering ability, especially in the case of a choppy adverse wind and small speed (three to four knots), when the ship sailed under the wind by the effect of the sailor accommodation of the raised bow.

Only the smallest, in extreme case (if the ice is not compact and not heavy) one should enter with small speed, and that only after the inertia of the ship is cancelled. After this when the ship enters the ice area, the speed of the course is increased (depending upon the conditions) up to the full speed.

A medium safe speed of the ship movement in the ice is determined within the limits of three to five knots, in which case even for one and the same ship the limits of the

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safe speed may considerably fluctuate. Taking into consideration that the "slow", the "medium" and the "full" steam ahead for each vessel, depending upon its tonnage, the powero of the machines and the shape of the hull, may be of a different value, one cannot determine the common denominator of the safe speed of the movement of the ships.

In rare evenly distributed ice sectors with one to three balls on the scale, in the absence of insertion into same of heavy solid ice masses, the speed of the vessels can be unlimited. In the rarified ice masses of four to six balls on the scale at an even distribution of the ice areas covering the water surface, the sailing speed of the ship is slowed down in accordance with the solidity and thickness of the ice.

It has been established by experience that each vessel with a metal hull, navigating at full speed, can break through, without especial effort the thin autumn ice. The vessels which have a strong hull and powerful engines, can sail in the ice, by developing full speed; in this case the thickness limit of the broken ice depends upon the size of the ship, the shaping of the underwater part of the hull and with the power of the machine plant. The greater is the draft of the vessel, with that much greater safety its propellers and rudders can operate, and consequently it can navigate with high speed. However, the greater the speed of the ship that heavier are the impacts of the ice against the hull. A field of young ice even with a thickness of 25 mm is sufficient to injure the hull of a ship as the machines develop full speed, and the ship is not adjusted for navigating in the ice-bound areas. Therefore if there is no proper coordination of the solidity of the hull, with the power of the machine plants, one should reduce the speed of the vessel.

The manouvering properties of vessels in the conditions of ice navigation are subjected to very considerable changes due to the rapid cancellation of the inertia and a powerful reduction of its maneuverability. Here the negative effect of the great length of the vessel is fully displayed.

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In the majority of cases the shipping vessels sail in the ice under the conduction of icebreakers. If the channel laid through by the icebreaker stays open, an echelon of two to three vessels can follow the icebreaker. The speed of their progress in this case depends upon the ice conditions, but cannot exceed the maximum speed developed by the slowest member of the echelon, that is, the whole echelon must adjust itself to the maximum speed of the least powerful of the ships of its component.

In light ice conditions the make-up of the echelon and the speed of its progress can be considerably increased. However, even at a slight ball force of the ice one should observe a great caution and bypass the large ice slabs that may appear. In the practice of the active Arctic navigation cases are on record when in the ice masses of two to three balls the ships suffered heavy injuries of the hull. So, for instance, the ship of the type of "LENINGRAD" sailing in the ice-bound areas of two to three balls with a speed of about ten knots, came across a heavy ice mass, by its external appearance not differing too much from the other ice slabs, which had been cut through by the stem. However it happened to be a solid old ice mound with a great draft and underwater ram. From the impact of same against the cheek part of the hull of the vessel sustained an injury to its hull through a hole of over two meters in size.

In the thin young and expanding ice fields, with powerful lateral wind and current, the ice behind the stern grew together, so that the ice slabs promptly climbed upon each other. In such a case the ship can follow the ice-breaker only on tow draft-, one by one, and at a slow speed.

In those cases when the entire mass of the ice is stationed without any movement in the form of a large ice field, kept in one place by some obstacles, it is advisable not to disturb its immobility, but to wait for the change of the wind and current, or bypass the ice tract (should this be possible by navigational set-up).

~~xAs~~ As the ship follows the icebreaker, the speed of its progress will depend to a great extent upon the visibility

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range (weather). The better the visibility, that much greater speed can be developed by the vessel, all other conditions being equal, since the ship captain can discover the heavy ice cover in proper time or the turn of the channel and take the proper measures in due time.

The essential conditions of successful conduction of vessels through the ice-bound areas is the speed of their movement, as well as the quantitative make-up of the echelon. The fewer vessels in the echelon, that much faster and more successfully they are towed by the icebreaker, and inversely, the more vessels are participating in the echelon, that much longer the echelon is stretched, that much more the channel is clogged up with the floating ice slabs and that much less can be the speed of the movement of the vessels. In addition, in the case of a large echelon the conducted vessels get stuck in the ice-bound area more frequently, and the icebreaker has to come back in order to chip off the ice brims from their hulls.

A great and decisive effect governing the speed in the movement of the vessels, when they are guided through with an icebreaker, is their solidity, the power of their machinery, and their adaptation for navigation in the icy regions. So far as the speed of the echelon is limited by the maximum of the possible speed of the weakest vessel, the presence in the echelon of a single ship with a weak hull and a weak machine plant delays the movement of the whole echelon. In such cases the icebreaker frequently is forced to tow the weakest ship, which, naturally, reduces considerably the maneuverability and is handicapped in its operations with the blows.

The speed in the movement of the echelon, depending upon the factors listed above, fluctuates to a considerable degree - from the tenths of a mile to six or seven miles an hour.

In all the areas where resort is made to the icebreaker conduction of the vessels, it has been established on the basis of sailing experience for several years in

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various portions of the sea, that for a certain part of the year the average speeds of locomotion should be used. These speeds are the foundation for the make-up of plans, charts, graphs and sailing tasks to the ships.

From time to time depending upon the experience gained, the availability and perfection of the icebreaking means participating in the conduction, and the composition of the guided vessels, it is found advantageous to revise the planned speeds.

In the practice of the active Arctic navigation many cases are on record, where a less powerful and strong ship, whether on its own or under the guidance of an icebreaker, arrived, promptly and safely, without any damage, to the ports of assignment, while a more solid and powerful ship was subjected to ice injuries, was detained on a trip, had to stop over for the winter, or was forced to return, without completing its task. This confirms once again that for the success of the task the decisive is the experience of the captain and his assistants, their familiarity with the conditions of navigation and especially the peculiar features of their own vessels, as well as the good work of the crew and the machine complement. If the captain is convinced that every order from the commander's bridge about the change of the speed and direction of the course will be promptly and properly complied with, he can work in confidence, with full speed, and consequently, increase the speed of the movement of the vessel in the icy regions and deliver it in the port of assignment without any damage.

CHAPTER VIII

STEERING OF THE VESSELS DURING NAVIGATION IN THE ICE-LOCKED REGIONS

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Section 35. Steering the Icebreakers.

For a successful sailing in the icy areas it is not sufficient to know how to steer the icebreaker and to maneuver in a complicated ice situation, alone, but also to be able to properly analyze the nature of the ice and to properly select the line of the course, to utilize the local conditions, the short-term and long-term prognostications, the aviation reconnaissance and to form skillfully the echelons of the conducted vessels. Without this even the properly executed maneuvers by the icebreaker cannot always give positive results.

The basic task of the icebreakers is the conduction of the vessels in the ice-locked areas. Along with this the icebreakers must be of assistance to the ships in taking them off the shoals, to repair their holes in the hull. Sometimes the icebreakers are used also for immediate shipment of the freight to the points which are inaccessible by the condition of the ice for the transportation vessels even under the guidance of the icebreakers.

When the icebreaker is selecting the sailing course, it must lay its course with no regard to the lengthening of the trip, through the most passable ice areas. This is advisable both from the point of view of the speed of conduction of the vessel in the ice-locked areas, and also from the point of view of the safety of navigation.

An exceptionally important matter in the securing of the successful operations of the icebreakers, is a well-organized weather forecasting service in the area of the icebreaker operations. The fairly detailed weather reports and reviews on the condition of the ice masses, received in due time, make it possible for the icebreaker to select the least hazardous, the shortest and easiest road.

The airplane reconnaissance of the ice conditions is of decisive importance in the active Arctic operations. For the ice reconnaissance in the freezing seas the airplanes for both long and short range flights are used, all of which

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are based on permanent airfields or water-way stations. They are carrying on a systematic reconnaissance in a determined area and are dropping the flag and charts of the ice situation directly on board the icebreakers and ships navigating in this area. The ship flag consists of a long thin cable with a hermeneutically sealed metallic pencil case at the end; in this case the bluprints are inserted. On the surface of the blueprints the ball scale and the powerful conglomeration of the ice masses is drawn with colored pencils and conventional marks.

After the end of the flight the information about the ice situation is transmitted by the pilot also for the guidance in the conduction of the ships by radiogram, or by direct conversation with the radio station UKV (ultrashort waves). In an especially complicated situation the airplanes of the ice reconnaissance hover above the ships, pointing out for their benefit the least hazardous route.

Besides the pilot and the navigator, on board the airplane reconnoiterer, usually a specialist hydrologist (or a group of specialists) is accommodated with the assignment to mark up on the chart the disposition, compactness and the massiveness of the ice groups.

For their conduction in the ice channels the ships are organized into echelons. The make-up of the echelon is based on the selection by the guide of the ice conduction in participation with the captain of the icebreaker. Quite frequently this task is entrusted directly to the captain of the icebreaker. From the properly selected make-up of the conducted vessels and the rational formation of the echelon (intervals in the order of sequence behind the icebreaker) the success of the operation depends a great deal.

Sometimes the order of sequence of the vessels in the echelon at the exit from the port into the sea it is advisable to change, depending on the condition of the ice. So, for instance, sometimes the weak ships which at their departure from the echelon will be, when leaving the port, placed immediately behind the icebreaker, must be disposed at the end of the echelon. This makes it possible in the

first place and more rapidly to lead through the more powerful and solid ships. However, the weak ships can be taken on by the icebreaker in the second turn, after the strong ships have been conducted to the necessary points or to the outlet in the sea, where from that point on they can proceed independently. In those cases where the channel behind the icebreaker remains open for the passing of the first ships of the echelon, and then is covered up again with ice, the weak ships follow directly behind the icebreakers, etc.

The success of the icebreaker conduction depends to a high degree, not only upon the condition and nature of the ice, weather and navigational conditions, the technical conditions of the ships, their adaptations to the active Arctic navigation, but also upon the power and the properties of the icebreaker itself, its installations, its provisions, the full complements of the crew and the commanding groups, autonomous privileges of navigation, the kind of fuel, etc.

When conducting the ships in the ice areas the most hazardous is the case when the icebreaker gets stuck in. This draws along the immobility of the entire echelon, while the ships, stuck in heavy ice, cannot budge from the place on their own. In order to make it possible for the echelon to proceed, the icebreaker must at first cut through a channel for itself, and then shave off the hulls of the ships of the echelon the ice from their hulls. The icebreaker may get stuck in the ice area because the heavy accumulations of ice masses had not been detected in proper time in the direction of its course. But more frequently the icebreaker is stuck because the power developing by same is not sufficient to overcome the oncoming ice masses, while it happens to be impossible to bypass that obstacle.

On board the steamer icebreakers the cause of wedging in may be unsatisfactory work of the firemen or the low quality of the coal, which will bring about insufficient steam pressure in the boilers and incomplete use of the machine power.

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During conduction of the vessels in heavy ice conditions the icebreaker must have a reserve of power to overcome, in case of necessity, the accumulation of the heavy ice masses without stopping. It is quite important to save the ships of its echelon from slowing down their advance, to save them from losing their inertia, the preservation of which safeguards in many cases uninterrupted sailing.

The number of vessels making up the echelon, is quite varied, and depends upon the convenience of passing through the ice, and also upon the power and the number of icebreakers participating in the operation. For instance, in the ice-bound areas of the Bay of Finland, one heavy duty and one auxiliary icebreaker are sufficient for normal conduction of an echelon consisting of three to four ships. In a large composition of an echelon it is necessary to have several auxiliary icebreakers, since already the third ship following the icebreakers experiences a considerable resistance of the ice which will fill the channel.

The echelon is called "simple" if a group of ships follows one single leading icebreaker; in doing so on a parallel course or in the center of the echelon an auxiliary icebreaker can follow.

The echelon is called "complicated" when a group of icebreakers conduct a group of ships; for instance in front of the echelon the heavy duty icebreakers proceed, while in its wake two or three ships follow, then again a new icebreaker comes followed by a group of vessels in its own turn, etc. (Figure 48). In the tail of the echelon they usually do not assign an icebreaker, since it cannot be of any practical aid in the process of conduction and will be of any use only in the case when the vessel gets stuck in the ice.

Figure 48. A complicated echelon in the wake of the icebreaker.

/Top, left - the icebreakers. /Right - the conducted ships.

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The general guidance in the conduction of the ship in the ice-locked areas, as it had been indicated above, is usually placed on the responsibility of the captain of the leading icebreaker. He is entrusted with the disposition of the ships in the echelon. The ships of greater width, as a rule, follow directly the icebreaker, while the narrower ones proceed in the tail of the echelon. On the other hand the ships with the weakest machines must be as close as possible to the icebreaker. If both these groups are incompatible, then the weakest ships are disposed in the center of the echelon and in front of them an auxiliary icebreaker is placed. Sometimes the most powerful ship is disposed in the center of the echelon, in such a place where the channel is filled with the floating crushed ice, so that it should clear the channel for the following vessels.

The vessels stuck in the ice while sailing within the echelon, are aided by the auxiliary icebreaker. It passes along the hull of the beset vessel and by chipping off the ice, widens out the channel. In an immobile ice this is sufficient and the stuck-in vessel can again resume its progress.

If the leading icebreaker runs on its course into heavy ice banks, which it cannot bypass for one reason or other, then by stopped with the signal the ships following it, the icebreaker moves away by a rear run and giving it a run ahead, attempts to force the impassable place with a dash. The icebreaker repeats this maneuver until it succeeds in breaking through the obstacles.

Sometimes it is more advisable to bypass a heavy obstacle and find a more passable line, even for the account of lengthening its course. In such a case (in the absence of the airplane reconnaissance) the icebreaker will conduct "the reconnaissance by its hull", that is, by stopping the echelon, "it will probe the ice in different directions".

The conduction of the vessels is connected with great difficulties in the drifting ice, especially when the drifting proceeds in a direction close to 90° with reference to the course of the echelon. The channel behind the icebreaker

fills in quite rapidly with ice, which makes it quite difficult, and frequently impossible to have the ships follow the icebreaker.

Quite frequently the conduction of the ships becomes so difficult that it is necessary to change the course, by laying it out along the line of the drift or meeting it; sometimes the drift of the ice may be utilized for the assigned progress of the ships.

In winter or in early spring quite frequently a fairly wide channel of free water is formed right in the center of a heavy and solid ice. Naturally, it is quite tempting to use such a channel for the conduction of the ships, if its direction is in line with the course of the ships. However, in the practice of the active Arctic navigation there have been cases when an icebreaker with an echelon of ships or just one ship alone, entered such a channel and successfully completed their trip. However one cannot recommend to sail in such a channel since it may end with heavy damage or even the loss of the vessel. The channel between the large heavy masses of ice may be compressed under the effect of the wind or currents. In doing so huge fields of ice frequently get pressed together as a result of the unequal pressure upon each other: one field may move faster, the other slower. One field may keep staying without any movement, while the other may be drifting along the channel and finally both fields or one of them can get into a spin. If in the first case, at straight immediate compression, the ship with a hull which is not sufficiently strong, may be injured or crushed by the sharp edges of solid ice fields, then in the second case it gets in between two surfaces of the edges of the ice rubbing against each other with terrific force, and may be cut apart by them.

Considerably difficult is the navigation in the ice masses when the ice groups get compressed. This phenomenon is observed also during the drifting of the ice masses. Sometimes the compression reaches such a force that not only the usual type of vessels, but even powerful icebreakers are deprived of a capacity to move and are exposed to damage by

ice masses. If the compression of the ice masses is not sufficiently powerful to fully paralyze the sailing of the ships, the distances between the latter must be reduced to a minimum.

If the ships get stuck in rapidly, their conduction is slowed down to such a point that it is more advisable to stop the echelon until the compression is discontinued. In the practice of the active Arctic navigation there were cases when the icebreaker in a vain attempt tried to proceed along the compressing ice masses, spent the fuel and fresh water, and when with the change of the wind, the ice situation had improved, he could not utilize it because of the insufficiency of the supplies.

In a case when the ships of the echelon and the auxiliary icebreaker cannot safeguard their movements behind the heavy-duty leading icebreaker, the leading icebreaker chips off the ice - deploys in the opposite direction and passes along the lee side of the stuck-in vessels in as close to them as possible (Figure 49). After this the icebreaker will again deploy from the wind side, passing for the second time along the ships, bypassing them, and emerge into the front of the echelon.

Figure 49. Disposition of the courses of the icebreaker, during the chipping off of the vessel that was stuck in the ice tract.

/Above - Direction of the wind.

The chipping off of the ice can be effected also by other means, depending upon the direction and the force of the wind, of the condition of the ice. On Figure 50, I, the icebreaker is seen in front of the stuck-in ship, while the heavy ice does not permit the icebreaker to deploy with the necessary speed in order to carry out the chipping-off process. In such a case the icebreaker passes with its own

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stern along the side of the vessel, at a safe distance from same, since at the rear run the steering of the icebreaker is considerably worse than at the forward run of same. Passing in such a way behind the stern of the vessel needing chip-off, the icebreaker will give a forward run, after which it passes near the side of the vessel being chipped off, since in the opposite case no positive results will issue from the chip-off. The distance at which the icebreaker may pass by the chipped-off vessel depends not only upon the nature of the ice masses, but also upon the size of the icebreaker itself and upon the solidity of the hull of the vessel needing chip-off assistance.

When chipping the ships with weak hulls, by a powerful icebreaker, in the conditions of heavy, monolithic ice masses, there were cases when the plating of the ship did not stand the powerful pressure of the ice when the icebreaker passes at a distance of eight to ten meters away from the chipped-off ship. One one of the ballast ships, during the chipping-off procedure in the ice masses of the Bay of Finland several frames in the stern holds were broken in such a manner. Similar cases have been recorded in various other basins. The thinner and weaker the ice and the stronger the hull of the vessel under chip-off, that much less can be the distance between the ship and the icebreaker during the chip-off process.

Figure 50. The simplest diagrams bearing on the chip-off of the ice by the icebreaker.

/Top of block, left - Icebreaker. /Next, right - The ship.
/~~Maxim~~ /Below - Movement forward with the bow.
/Below - Movement backward with the stem.
/Bottom - Deployment of the icebreaker.

In heavy ice masses the echelon of the ships, made ready for departure, cannot take off without the preliminary chip-off. For this reason almost each time one or several ships are being chipped off by the heavy-duty or auxiliary icebreaker. The echelon pushed off its place proceeds after

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the icebreaker in the channel, densely filled with heavy ice, very slowly until, for some reason or other it does not stop. Even after a short stopping of the vessel the forward movement cannot be continued ~~mm~~ without the previous chip-off, since they are instantly compressed by the dense mass of the ice.

On the diagram of Figure 50, II, one can see the chipping-off of the ship by the icebreaker in the conditions of light ice masses. The icebreaker overcomes the ice freely, which makes it possible for same to deploy without difficulties to the reverse course, behind the stern of the chipped-off vessel, here deploy once more and, after chipping off the sides of the vessel, return in the initial position. The advantage of such method of chip-off consists in the fact that the icebreakers during the backward run, as well as forward run, proceed by the forward run, is well steered and can pass twice at a short distance from the ship.

On Figure 50, III and IV, the particular cases of the chipping off of the vessels are shown by the icebreaker in the process of the formation of the echelon. In the case presented by III of Figure 50, the icebreaker at the moment when the ship gets stuck, is disposed toward the same by the bow, passes on with the front run under the stern of the ship, where it deploys for the reverse course and passes for the second time along the side of the ship. In the case presented on Figure 50, IV, the icebreaker is under the stern of the chipped-off ship, passes once along its side with its forward run and begins to conduct.

If several powerful icebreakers participate in the conduction of the ships, a method can be used which in the icebreaking practice is called the "recession" formation, or "for chip-off" formation (Figure 51). This method is used both in the light and heavy movable ice masses, when the channel is promptly pressed in in the wake of the ice-breakers, during the stuck-in condition of one or several of the guided ships of large tonnage. If the channel is compressed rapidly in light ice conditions, then in the presence of one heavy-duty and one auxiliary icebreakers,

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the ships are moving behind the heavy-duty icebreaker, which is sailing from the wind side. The auxiliary icebreaker proceeds during the ship-off from under the wind side (to the hull behind the heavy-duty icebreaker); its task is to widen out the channels in the wake of the leading icebreaker. In a heavy ice, in place of the auxiliary icebreaker there is need for the second heavy-duty icebreaker, since the power of the auxiliary icebreaker is insufficient for the execution of this task.

Figure 51. The "echelon" line (for ship-off operation).

/Top, left - Current.

The ice broken up behind the basic icebreaker from the weather side, at a lateral wind, will promptly shift into the lee channel, which remains behind the second icebreaker. In the weather side of the channel the clear water will remain and the conducted ships will proceed without obstruction. When the conduction of the ships is effected by three icebreakers frequently the "front" line is employed (Figure 52).

Figure 52. The "front" line.

The captains without sufficient experience in the navigation among ice masses, prefer not to use the "front" line, since they are afraid to injure the hull of the ship against the ice of the weather edge of the channel. This caution is not justified. In the icebreaker practice the front line has been used for many years, and in all this period no damage has been placed on record. The hazard of ice injuries is entirely the same both at the front line procedure and in the case when the ship proceeds by the lee side of the channel.

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The front line of the icebreakers is used under the same conditions as by the break line, but only in the case when the conduction is effected by powerful icebreakers, which are in a position to overcome a fairly heavy ice. Besides this the front line is used at the conduction of vessels in impassable drifting or immobile ice masses. In such ice conditions the conduction is possible only by a group of powerful icebreakers, following at a distance of one to two cable lengths from each other. In such line the icebreakers, so to say, chip off each other. The ice between the icebreakers cracks, weakens appreciably and the ice belt breaks into coarse and fine crushed ice. Quite frequently at the conduction with the front line the powerful icebreakers are forcing the ice with blows. On the other hand the auxiliary icebreakers, in case they participate in the conduction, tow the weakest and slowest ships.

If at a strong lateral wind in the conduction through passable ice tracts three powerful icebreakers participate, the ships usually follow the central icebreaker which is kept not on the front line, but roughly at a distance of the length of the hull in the back of the icebreaker. This makes it, to a certain degree easier for it to advance and speed is also better kept at an even rate.

When conducting the vessels along the front line by two powerful icebreakers and two auxiliary icebreakers, the ships follow the heavy duty icebreaker which proceeds in the weather direction. In doing so the central icebreaker is breaking up the ice between the channels which had been broken through by the two auxiliary icebreakers. The ice which is being shoved apart by the leading icebreaker, shifts in the neighboring channels. Due to this operation the basic channel widens out and is pressed in much less by the ice. Quite recently the method of ship conduction is used with the aid of three icebreakers such as it appears on Figure 53. The powerful leading icebreaker No. 1 proceeds in the weather direction. From the lee side of the leading icebreaker, at a distance of two to three cable lengths from same, the auxiliary icebreaker No. 2 proceeds by the brake. If the icebreaker No. 1 gets stuck in the ice masses, the auxiliary icebreaker No. 2 advancing forward, will chip off

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the ice all around it. From the weather side of the auxiliary icebreaker No. 2, by the brake-line the icebreaker No. 3 moves ahead, and following that the ships of the echelon sail directly.

Figure 53. Conduction of ships with three icebreakers.

/Top, left - Wind.
/Next - Current.
/Bottom - Direction of the course.

In such a set-up the ice surface is cut through by several parallel channels and does not press in the conducted vessels until the weather channels are filled with ice.

The captain of the icebreaker must take all the steps to guard the ships from ice damage while being conducted through the ice packs. Before all one must keep in mind that not one freight ship, even that which is adjusted for active Arctic navigation, cannot work with equal efficiency of an icebreaker; also the maneuvering properties and the mobility of a freight carrier is considerably more limited than is the case with the icebreaker. For this reason the captain of the icebreaker must go by the capabilities of the ships conducted by him, and never adjust those to the operations of the icebreaker.

The captain of the icebreaker must at all times watch the vessels conducted by him, and see that they should not lage behind and also by keeping, so far as possible, the shortest distance between the sterns of the icebreaker and the vessels in the tow line. If at the shores on the sand banks, which are accessible for the conducted vessel, but inaccessible for the icebreaker, there is clear water or weak ice, the captain of the icebreaker can suggest the vessel to proceed on its own, and he himself must pass through the heavy ice, without losing from sight the vessel that has been released. However, such a maneuver can be

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advised only amid very favorable conditions, and being thoroughly convinced that the direction and the force of the wind will not change during the perfod when the ship will sail on its own.

Under the effect of the changing currents or shifting winds the ship can be pushed out by ice on the shore, however, the icebreaker deprived of the possibility of approaching it due to its superior draft, will not be able to give it any assistance.

In general, as it is well known, the navigation in the ice conditions is frequently effected in unstable weather. The winds, fogs, poor visibility, snow blizzards, darkness may interfere with the successful progress of the ships. Moreover the ships can get into such places from which it is very difficult for them to depart, while the icebreaker is not in a position to offer him assistance. A weak ice can rapidly thicken and become impassable, it can press against the ships and draw them into drifts in the direction of the shore, shoals or sandbanks.

The passing of the ship by the coastal puddles surrounded by the overhanging ice flats, which may at the intensifying force of the wind shift to the clear water, is fairly risky even under the conduction of the icebreaker. Especially risky is the navigation through the shore puddles in limited depths and in the areas which had not been sufficiently investigated from a hydrological point of view. It is easy to get into the coastal puddles, but to get out from them into the ice, the edge of which can be well condensed or consists of fields of powerful ice, is very difficult and threatens with serious damage.

Thus to lead the ships into the coastal clear waters surrounded by the ice masses can be of advantage only in the case of a steady wind coming from the coast. Even in the weak ice tracts the captain of the icebreaker should not develop excessive speed and permit a too large a distance between the icebreaker and the conducted ships. One may always come across a heavy ice mass with an underwater battering ram or underwater blocks, which may cause a

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serious damage to the freight carriers, especially to the ones with a weak hull. At the ice conduction of the ships, the icebreaker must run into the ice edge under a right angle.

Before introducing the echelons in the ice the captain of the icebreaker must at first assign the order in the disposition of the vessels. As it had been said above, the weakest ship should be arranged first, and the most powerful ones the last behind the icebreaker; the distance between the vessels should be, so far as possible, the shortest to the limit.

While the echelon is being organized, the captain of the icebreaker must look for the most rarified tract of ice in order to start the leading of the ships in this place. Up to the moment before all the vessels enter the ice, and between them the assigned distance has been built up, it is not advisable for the icebreaker to make sharp turns, for the channel should be, so far as possible, straight. To introduce the ships in the leeward edge of the ice without extreme necessity is not advisable at all, and is permissible as an exception only in the case of those ships which are adjusted to the active Arctic navigation. Furthermore to lead them one by one at the shortest possible distance by taking each ship so far in the ice, that it should be entirely safe from the blows of the icebergs while the sea is waving.

If the captain of the icebreaker develops doubt in the fact that the echelon can pass through a certain given ice tract, he must reconnoiter with the hull, that is, pass without the echelon the necessary sector of the ice.

The sharply expressed weather edge of the ice, as a rule, does not exist. On the weather side the ice usually moves along in a rarified condition. The waving from the leeward edge of the ice does not exist (except in cases of swell). Only in very rare cases, at an insignificant accumulation of ice and a heavy swell, the wave spreads from the leeward edge to the weather edge of the ice, passing under the ice. ~~Xxxxxxx~~ However, also in this case the

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entrance of the ship in the weather edge is not hazardous, since the ice is then rarified.

At the progress in the ice conditions one has to take into consideration that the channel behind the icebreaker is best kept open if it is laid out in the direction of the wind and current. Setting out from this consideration, one has to lay one's course so far as possible.

The icebreaker must in no case lead the ships in the ice mounds, even though it will be necessary to lengthen the sailing course in order to by-pass them. In those cases when the icebreaker must force through the ice by the blows, the ships following the icebreaker must be at least two cable lengths away from the place of operation of the icebreaker.

The heavier is the icebreaker (fresh water, supplies, fuel, ballast) that shorter is its dash and more effective work, and, inversely, the lighter is the icebreaker that longer must be the dash and necessarily its work be less effective. This is explained by the fact that the force of the blow is determined as the product of the mass by the speed.

Practically in the majority of cases the force of the blow depends upon the time and distance needed in order to have the icebreaker develop full power and speed. This in its turn depends upon many factors and, in particular, upon the construction of the hull and the tonnage of the icebreaker, its load and draft, the technical conditions of its machinery and boilers, the quality of the tow (aboard a steam icebreaker) and, finally, upon the experience of the crew which services the mechanisms.

In one case the icebreaker condemned to a complete immobility at a distance of one cable length from the ice edge, in a condition after a full forward run was given, to develop the necessary power and speed.

In another case at a distance of three to four cable

lengths from the edge of the ice, it cannot develop full speed and full power after the machines had been given full speed forward. Therefore for the purpose of a powerful blow of the icebreaker's stem against the ice, one is not under obligation to retire by a large distance. One has merely to study the possibilities of his own vessel in various conditions of loading, and to know at what distance and in which period of time it can develop its full speed, produce the greatest power and inertia.

Along with the discussed sector the efficiency of the work of many icebreakers depends to a considerable degree upon the so-called "the active water line", or from the angle of the attack by the stem of the icebreaker against the ice. Each icebreaker has certain determined angle of attack, or the most advantageous surface of the water line, at which the ship destroys the ice with the greatest effect. With the reduction of the icebreaker's draft, when the fuel and water had been consumed, the icebreaker begins to operate less effectively, since along with the reduction of its weight also the angle of attack changes. At an excessive increase of the icebreaker's draft, even though its mass is also increased, the force of its blow at the ice is also reduced, since the angle of attack or its "active waterline" is deepened. Besides this at an excessive draft the icebreaker turns into an ice cutter, losing its ability to climb on the top of the ice and break it through with its own weight.

The overloading of the icebreakers during the spring and summer operations in the ice clearing will cause no damage since at this time the ice is usually thawing, not frozen and can be easily pushed aside in the tracts of free water which had formed between the ice mounds and ice fields.

However, also in this period as a result of excessive overloading and deepening of the most effective waterline impact of the icebreaker, when forcing heavy ice by rushing it, the weak part of the hull can sustain injury.

Furthermore the overloading of the icebreaker

deteriorates considerably its seaworthiness. The passage of the overloaded icebreaker, especially with a deck load, in open sea to the place of the ice conduction is dangerous. In the fall and winter the excessive overloading of the icebreaker is especially undesirable, since it will not be in a position to overcome the ice even up to 40 cm thickness.

However, in view of what had been said about the icebreakers operating on the coal fuel are systematically overloaded with fuel, waterf and other supplies. In the case of the icebreaker, provided with great supplies, the sailing range is more extended and during the prolonged ice conduction trips it must not waste time on stop-overs or calls in the ports in order to complete the supplies.

From the number of the icebreakers in operation at the present time, some of them have so important an "active water line" that the efficiency of their operation following the take-in of the fuel supplies is but slightly distinct from the efficiency of their work with consumed supplies. To the number of such icebreakers belong, for instance, "IL'YA MUROMETS", an auxiliary icebreaker operating on liquid fuel. A less "active water line" belongs to the icebreaker "ERMAK" and a far lesser one - to the icebreaker "LENIN".

As it is known, if the ice is not sufficiently solid, the icebreaker breaks it at first with its stem, then it breaks it and pushes it aside with the cheeks and the wider portion of the hull up to its middle. On the other hand, if the ice is solid, the icebreaker climbs on the top of it and breaks it through with its own weight, and pushes on the side the broken-up slabs and frequently presses them under the hull. As soon as the movement of the icebreaker following the impact against the ice begins to slow down, it is necessary to promptly set the rudder straight and give a full rear run in order to avoid the wedging in of the vessel in the ice.

After the icebreaker begins to move backward and is not handicapped by the ice, the speed has to be reduced to

the minimum, and then fully stop the machine, so that the icebreaker returns to its original position by inertia. If in this process there is a sufficiently solid ice under the stern, against which the rudder can be injured, together with the propellers, the machine has to be given a slight backward run. At the moment when the stern gets in touch with the ice the propellers must rotate with the smallest turns. As the icebreaker moves toward the rear, it is very important to keep it in the center of the channel, which is achieved not with the rudder, but with the aid of the engines.

Frequently during the time when the ice is being forced, the ice surface does not develop any cracks, but the ice is ground. If this happens to be the case, effort is being made to cut through the ice in such a way that every subsequent blow is aimed at a new spot. Otherwise there would be too many fine chips forming a "pillow", which will cancel out the subsequent impacts of the hull.

In case an ice ledge is met with on the course, which cannot be easily bypassed because of the sharp turn, the icebreaker must shave it off. When doing so, one has to keep in mind that the angle between the ice and diametrical surface of the icebreaker cannot be below 45°, since at a sharper angle the icebreaker will slide along the break with cheeks, and will not cut into it.

When conducting the ships in a solid immobilized ice, covered up with a heavy layer of snow, frequently a single passage of the heavy duty icebreaker is not enough to break through a channel of sufficient width. Already in the immediate vicinity of the edge of the ice will compress even the straight line channel, making the succession of ships difficult, while at turns their individual progress behind the icebreakers becomes entirely impossible. In such case in the absence of drift and the ice compression, the icebreaker must increase by double or triple passage the width of the channel. By such operation the wedging in of the icebreaker in the ice masses is almost impossible, and will make the maneuvering of the ships easier, as they follow in the echelon, while the hazards of ice injuries are greatly reduced.

The icebreaker can widen out the channel in several ways. With the first and simplest method the icebreaker, leaving behind the ship, proceeds ahead all by itself. After this it returns, yet not through the channel which had been broken through in its advance movement, but next to it, thus enlarging the channel and by conducting through same the vessels by separate, more or less prolonged, stages depending upon the conditions. If the channel is filled with ice precipitously, the sectors of conduction must be shorter, while the icebreaker must return more frequently or pass several times by one and the same course; however if the channel is covered with ice more slowly, the icebreaker can return to the ships less frequently.

The above described method is used in case the icebreaker by its own power, and ice conditions, can proceed with continuous speed. If on the other hand one must progress in ice only with blows, other ~~method~~ methods are used.

In heavy frozen, bulky hummocky ice masses the icebreaker must widen the channel by "Christmas tree" shape (Figure 54), that is, by operating without alternating blows both the right and the left edge of the channel. The icebreaker thus operates when it gets stuck itself in the ice and after each rush for the blow at the ice it movesahead only half the length of its own hull, gets wedged in and for its release must use the transfusion of the ballast, that is, the trimming and listing.

Figure 54. Widening of the channel by "Christmas tree shape" (the figures stand for the subsequent position of the icebreaker).

If it is necessary to provide a triple channel, then the blows at the ice must so alternate as it had been shown on Figure 55 (to the right, to the left and in the middle). When the icebreaker operates in such a manner, its maneuvering is complicated by the thick mass of crushed ice, which

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not only makes development of the sailing speed difficult for the purpose of rush momentum, but even cancels the blows of the icebreaker against the ice.

Figure 55. Laying of a triple channel by the icebreaker (the figures stand for the subsequent position of the icebreaker).

If in the line of the ships an auxiliary icebreaker participates, one can use it for the break-through of the channel "by the Christmas tree" method. In this process the heavy-duty icebreaker takes the auxiliary icebreaker in tow, in its own stern excision. The auxiliary icebreaker pushes against the stern of the heavy-duty icebreaker which sails with a forward speed and helps it to get rid of the wedging in, by operating with its rear run.

Participation of the auxiliary icebreaker in the operation, even though it makes the break-through of the channel easier, affects adversely the steering capacity of the icebreaker, especially at reversed runs, when the stern of the auxiliary icebreaker makes a deep indentation in the edge of the channel ice. The heavy-duty icebreaker must be stopped and in order to correct on the sailing directions, must give alternating moves forward and backward.

After the channel had been laid out, the heavy-duty icebreaker must, as the icebreaker captains say - "iron it out", that is, grind the crushed ice, in order to make the advance of the vessels easier.

One should keep in mind that if the ships get stuck in such a channel, their release will require a great deal of time and the use of force. For this reason in similar cases it is necessary to determine first, whether the ships can be towed by the icebreaker within the stern excision, or close to the stern, yet without the risk of collision. In this case, if the icebreaker is wedged in in the mass of ice, the ship following it must promptly stop its own run

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in order to avid the rush or blow against the stern of the icebreaker.

In general, the ships proceeding through the channel laid out by the icebreaker in heavy ice, must after each stop of the icebreaker and its rear run give a full forward run as fast as possible. In doing so a powerful current from the propellers effects, in the channel behind the stern of the icebreakers, a powerful shifting of ice. Not every guided vessel is by far in a position to overcome this shift, and the icebreaker has to return to the stuck-in vessel (in the majority of cases with rear run) in order to break it up. After the first ship passes through the channel, usually the other ships of the echelon are passing on their own, without the supplementary aid of the icebreaker. In rare cases the hull of the icebreaker is considerably narrower than the vessels taken under tow, the triple channel is insufficient. In such a case the icebreaker with a considerably greater loss of time may widen out the channel, by repeating the break-through procedure of the triple channel. At that the captain of the icebreaker must see to utilize the wind and currents and break the ice in such a way that its crushed parts are taken away.

The interval between the ships and the icebreaker varies a great deal, depending upon numerous conditions, before all on the reliance of the icebreaker captain on the fact that the icebreaker can proceed with equal speed and will not get stuck in. So, for instance in the thin ice loded areas, in the absence of compression and tracts of packed laminated ice, at good visibility one can establish between the ships short intervals. Usually in such conditions at an even speed of advance and the rectilinear sailing the intervals between the ships are established from one to two or even three lengths of a vessel (depending upon the ice situation).

At the conduction in heavy ice conditions, when the icebreaker gets stuck and there is no reliance on the prospect that no impassable ice masses will be met with, and also during conduction of weak ships, whose bow parts of the hull get powerful jolts from the ice mass, which are pushed apart with the current from the icebreaker's

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propellers, the intervals between the icebreakers and the head vessel of the echelon is somewhat increased. During slow progress in heavy ice all the machines are usually operating with full speed, and the current from the propellers becomes very powerful; the pieces of ice cast by it may injure the hull of the vessel. For this reason/in such conditions the interval between the stern of the leading icebreaker and the bow of the head vessel of the echelon must be still greater, in order to be able to cancel the inertia of the heavy pieces of ice, cast away by the current coming from the propellers of the icebreaker.

When conducting the ships in a rarified ice - five to six ball scale with the belts or accumulations of ice met with on the sailing course, the channel behind the icebreaker even in the absence of the wind stays not very long. Therefore the intervals between the ships must be as short as possible. In the case of unexpected stopping of the icebreaker, or of the ship heading the echelon, each subsequent vessel may easily be pushed out from the wake.

When conducting the ships in fog they must keep away from the icebreakers and from each other within the limits of visibility.

In all cases when conducting in daytime in the conditions of favorable weather, the ships must keep away from the leading icebreaker at a distance of audibility of its siren. In the dark period of the day it is not advisable to establish short intervals between the ships, or this may lead to the rushing on and injuries caused to the stern.

The interval between the icebreaker and the head vessel of the echelon depends a great deal upon the tonnage of the vessel and its steering capacity. One should not go for two short intervals between the icebreaker and the leading vessel of the echelon which carries a heavy load, for instance, one of the type of "LENINGRAD". If the icebreaker stops unexpectedly or slows its speed in the face of some ice obstacle, the ship will not be able to cancel its inertia and may strike with its bow against the stern of the

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icebreaker. One should avoid turns in the ice, especially sharp turns. The turn must be as smooth as possible, in a low gear and at a small distance of the ships, one from the other and from the icebreaker, in the ice holes or in the rarified ice.

When proceeding in a heterogeneous ice, the icebreaker is being tossed from one side to the other toward the weaker ice, all thus being done in conformity with its size and water displacement, and also in conformity with the power of the machinery. As a result of this the channel becomes curved, which makes the guidance of the ships difficult. The use of the rudder in such cases is almost useless, is ineffective and the direction of the icebreakers' progress must be regulated also by the lateral machines (in case there are two lateral machines) by increasing or decreasing their sailing speed.

It is quite obvious that when from the blow of the cheek portion against the ice the icebreaker will be cast sideways, and therefore the rudder cannot hold it on its course. However, this does not mean that the rudder is of no assistance in steering. If the rudder were altogether ineffective, it would be very difficult to hold the icebreaker down to its course, or even impossible.

At the experienced steering with the machines and the rudder even in complicated conditions one can lay relatively straight channels, thus speeding up the conduction of the vessels and making the progress easier.

The rudder is able to counteract, to a certain degree, the ship of the icebreaker's direction under the effect of a blow against the ice mound, only in a set-up where it sails in the rarified ice cover of five to seven balls. The debris of the ice fields or bulks of crushed ice are met with on the course of the icebreaker with the abutting protrusions and edges. The impact can be foreseen ahead of the time and the rudder can be shifted, still soon enough, to the proper side. But even in such conditions one must resort to the assistance of the machinery in order to reduce the deviation of the icebreaker and to lead it out the soonest possible to its course.

The yawing of the icebreaker caused by the heterogeneity of the ice cover is expressed sometimes in very sharp tossing to the sides in such a degree that one cannot hold down the ship to its straight course either with the rudder or with machinery. In such cases one should test the operations under different conditions of work, and change the number of the propellers' revolutions as well as to select the scheme of work with which the icebreaker will be tossed sideways as little as possible.

If the icebreaker detects in its course the fields of a more solid ice than the one through which the echelon proceeds, they should be bypassed or broken up, which is less desirable. In very heavy ice-locked areas where the echelon cannot sail normally, it is advised to lead the echelon by single parts, and in exceptionally difficult conditions it should take each vessel on tow.

When navigating in shallow waters the icebreaker must have a maximum of the ballast water, and also keep ready the means for its rocking.

The trim on the stern should be as slight as possible and if the icebreaker is well steered, one must apply a slight trim on the bow or to keep the ship on an even keel.

The width of the channel in wake of the icebreaker theoretically equals the width of its central part, however practically it is somwhat larger, since the round sides of the icebreaker further chip off the edges of the channel.

In the ice fields 35 to 60 cm thick in many places the channel in the rear of the icebreaker is greater than the width of the latter. This is explained by the fact that the edges of the brittle ice are not so fully broken up b y the hull of the icebreakers, but they are chipped off also due to heavy friction of the ice water line. As an icebreaker keeps sailing ahead, the channel will gradually be filled with ice slabs, emerging from underneath its hull and from the ice edges, and also with the ice masses broken off from the edge of the channel under the effect of the streams generated by the propellers of

the icebreaker. For this reason the ships following the icebreaker closely should come as close as possible to same (as much as the ice pieces cast out by the propeller stream will permit). In the immobilized ice the usual distance between the icebreaker and the closest ship following it, is about one to two cable lengths.

In the ice tracts 45 to 60 cm thick the edges of the channel are broken up not smoothly, but with teeth (especially in a continuous smooth even ice). At the compression of the channel these teeth may cause injury to the ship proceeding in the wake of the icebreaker, since the pressure of the ice is not distributed evenly along the entire water line, but operates as a concentrated load-up only in separate places.

The wider is the channel that much easier and freer the ship following it. By keeping to the wake of the icebreaker, they advance along the axis of the channel in such a way that between their sides and edges of the ice there is some free space left, filled with a fine crushed ice. The sailing speed of the icebreaker with the ship echelon is regulated by the captain of the icebreaker in accordance with the thickness and solidity of the ice, and also in accordance with the positive properties of the conducted vessels. Usually in favorable conditions it will be between six and eight knots, on an average.

Section 36. Steering the Ship While It Follows the Icebreaker.

As the ships follow the icebreaker on the bow of the ship one should install a fairly solid fender, which could relieve to a certain degree the force of impact.

The most advantageous at sailing in ice conditions is the system of anchors, which are stored away in the

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hawser receptacle. If the blades stick out from the hawser shelter, the anchors should be taken on the deck. As long as the ship is sailing in the ice-locked tracts anchors are not needed, and the sticking out blades may be the cause of serious injury to the vessels when they run into each other. Besides this after the removal of the anchors on the deck the anchor shelters are made free and they can be used for the installation of the tow cable.

As it had been said above, in accordance with the Regulations now effective in the USSR, the captains of the vessels following the icebreakers in the ice conditions, are to comply with the orders of the captain of the icebreaker in regard to the movement in the ice. Thus, being taken on by the icebreaker for conduction in the ice, the authority of the captain of the freight carrier is limited to the independent piloting of the vessel. The vessel which follows the icebreaker becomes a part of the echelon subjected to the orders of the captain of the leading icebreaker. However, the liability for the fate of the freight carrying vessel which follows the icebreaker is not removed from the captain of that particular vessel.

For this reason the captain of the freight carrier, his assistants and the other members of the ship crew must be thoroughly familiar with the rules of the leading of the vessels through ice tracts. The ships following the icebreakers must take their sequential place in the formation in accordance with the orders of the captain of the leading icebreaker.

The conduction of the vessels in the ice-locked areas, as a rule is effected in the line of the wake. The captain of the ship conducted through the ice must comply rigidly with the line of procedure through the wake and he has to keep the distance, that is, the interval up to the icebreaker sailing ahead of it or of another vessel of the echelon. Every attempt to bypass the ship in front of it or proceed by one's own independent course is strictly forbidden.

Cases are on record when the ship following the icebreaker speeds up and tries to leave the channel laid out

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by the icebreaker. This, as a rule, ends with the experience that the ship strikes with its stem or cheek against a solid ice and is sharply cast off sidesways. The yawing cannot be stopped or reduced either by the rudder or machinery.

The ship which disturbs the sequence of the echelon, in the best case will have its hull damaged in its impact against the ice, but quite frequently causes a blow to the icebreaker or the ship sailing ahead of it.

In the practice of the active Arctic navigation there were such cases when the ships desirous of proceeding independently and while looking for a better line of advance, deviated from the course, got loose from the echelon, got into the impassable ice, from which they could not get out without the aid of the icebreaker, and so detained the whole echelon.

The captain of the freight carrier must taken into consideration that the inertia of the ship in the clear water is being cancelled by the rear run, on an average at a a distance of about three to three and one-half lengths of the hull of that particular vessel (depending upon the power of the machine, tonnage of the vessel, its loading, the stress of the propeller and the number of its revolutions, the direction and force of the wind and current, the presence and direction of the waves and other causes). Consequently, in the rarified ice masses one should not keep the distance over the three to three and one-half times the length of the ship even at a full run and at a great momentum. It is obvious that when sailing in the compact ice areas the distance must be smaller than in the case of the rarified ice tracts. The lesser is the sailing speed, that much lesser must be the interval between the two.

In all the cases the distance between the ships following the icebreaker or after another ship must be sufficient to check the momentum of inertia, and also in order to be able to turn away in case of need from the wake into the ice. However, in heavy ice the ship cannot always leave the channel, since the edge of the ice may turn out

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to be exceptionally solid; in such cases one should be prepared to give promptly the full speed backward.

Besides this, if the emerging and separated ice slabs suddenly closed the channel, which had been laid out by the icebreaker, it is necessary to sharply reduce the speed or stop the ship. Finally, one has to avoid collision with large icebergs and if that is impossible, one should reduce the speed and try to meet the impact with its stem. Each captain of the ship following the icebreaker must at all times be ready to change sharply and promptly the speed of his vessel, should necessity call for that. The watch engineer or the machine attendant cannot get away from his control post even for a short period of time.

The ships conducted by the icebreaker must have their trim on the stern (or the protection of the rudder and the propeller from injury). This is usually achieved by the disposition of the load in the holds, or the ballast water in the tanks and in the compartments in between the bottom. However, the trim on the stern must not affect the steering of the vessel, especially the one provided with the ballast. In the practice of active Arctic navigation quite a number of cases have been recorded when an excessively heavy trim on the stern affected most adversely the steering of the vessel, especially in unfavorable strong winds; the ship drifted with its bow under the wind and, not having an opportunity to be normally steered, hit with its cheek part against the ice.

At powerful blowms of the propellers against the ice it is necessary to promptly reduce the speed, or to bring the machine to a halt. After this the speed should be resumed with a great caution, beginning from the slow speed and gradually bring it up to the assigned speed.

The strict observance of the distance between the ships of the echelon during the conduction through the ice, is necessary in the first place for the optimum use of the channel after its being laid out by the icebreaker.

When strictly observing the distance the ship following immediately the icebreaker, pushes apart the ice slabs

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emerging in the channel, with which it makes the passage of the ships following in the rear, much easier. If the distance is not observed properly the channel will sooner be covered up with ice. The utilization of the channel which remains in the wake of the icebreaker or by the ship sailing right in front, is fairly complicated, especially for the captains, who do not have sufficient experience in the joint active Arctic navigation, as a teamwork.

Quite frequently the echelon in a joint conduction through the ice is composed of ships of varying types: with a varying maneuverability, with a varying capacity to increase or decrease the speed of their advance and to the prompt change of the speed from the forward run to reverse and in the opposite direction. Such ships have distinct sharp "slow", "medium" and the "full" sailing speeds.

In connection therewith it is almost impossible to observe the proper distance in the line of sequence, except by using the machine telegraph. The ships will either catch up with the icebreaker too fast, or catch up with each other, or inversely they will lag behind. This can be avoided only by a previously set up system of the increase or decrease of the number of revolutions per minute of the machine. The command to the machine plant is passed on by the conversation tube, by telephone, or by ringing of the bell. On the commanding bridge one should have a special table in which the correspondence of the number of revolutions of the machine is indicated in relation to the sailing speed of the ship.

The maneuverability of the ship must be a matter of the educational fitness of the captain and those of his assistants who are keeping the watch independently.

When observing attentively the ship sailing in front, one should not experience the fear that one will ram it. The practice of the active Arctic navigation through many years has proved that the dangerous moment of too great a proximity of the vessel following in the rear has always the power to reduce the speed, to stop the ship, or back up on its course, to turn to the sides of the most effectively crushed ice in the proper time. Besides maneuvering

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with the aid of the rudder, with the proper turn of the propeller and the full speed backward the ship will promptly turn to the right, by whichmaneuver the contusion will be averted or softened to its minimum.

In ordinary conditions of navigation in the wake line, the control with a view to preventing the disruption of the distance to to prevent collision is placed on the ship sailing at the tail end of the echelon. In the Arctic navigation the captain of each vessel in the echelon must at all times take care of the ship following right behind it, so that the collision of the ships almost exclusively depends upon the sharp reduction of the sailing speed, or the stopping of the ship sailing right ahead.

By attentively observing the ice situation the captain of the icebreaker or of another vessel sailing right ahead frequently can foresee, in due time, the wedging in, the necessity of sharply reducing the sailing speed, or the need of stopping the ship altogether. However there are cases when the condition of the ice and passability cannot be determined with sufficient accuracy.

So for instance, the icebreaker "KRASIN" was towing in the Bay of Finland the German steamer "FILA" of medium tonnage with a full load of milled lumber. The towing took place in a January ice, quite light and of many types, with a speed of six to seven knots by a towing cable about 18 meters long. The icebreaker had a great reserve of power and was observing an even speed. The visibility was good. The wind was weak. On its trip the icebreaker came across a small field of pancake-like frozen compressed ice, with the small edges sticking up over its surface.

The pancake-shaped ice happened to be tremendously compressed and viscuous. It refused to break under the blows of the icebreaker's stem, and refused to crack, but was bending, thus cancelling the power of the icebreaker. In this kind of ice the speed of the echelon was reduced to two knots. The three engines of the icebreaker were given full speed forward, and a signal was transmitted to

the towed ship to give full speed backward, since the cable weakened, and the ship was coming close to the icebreaker threatened with contusion against the same.

As it advanced to about one-quarter of the length of the hull, "KRASIN" got stuck. The towed vessel, on the contrary, regardless of the fact that its engines were given full speed backward, approached the icebreaker fast. Operating with the reverse speed the steamer "FILA" was sliding with the right cheek part along the edge of the channel, however, it could not cut in the ice and stopped roughly two meters away from the icebreaker, between the end of its stern and the edge of the channel ice.

In this parficular case the blow of the steamer "FILA" against the stern of the icebreaker was averted through operation of two forces, which threw the bow of the steamer to the right and which were effective in cancelling its speed: in the first place through the operation of the machine full speed backward, and in the second place with the powerful stream from the icebreaker's propellers affecting the left cheek of the ship.

We can refer to still another a interesting example. The icebreaker "ERMAK" was conducting in the Kara Sea the steamship "KUZNETSKSTROY" fully loaded up. The ice was heavy and of various characteristics: there were fields, debris of the fields, large slabs up to nine to ten balls. But there was no wind and the channel kept open behind the icebreaker. The icebreaker "ERMAK" advanced with a speed of up to six knots, while the steamship sailed behind it with the same speed at a distance of fuur to five cable lengths. Suddenly the icebreaker got stuck in a heavy solid ice, which from the commanding bridge differed but little from the ice which was overmome by the icebreaker without especial effort.

All three machines of the icebreaker were given full speed ahead and a signal was sent to the steamer "KUZNETSK-STROY" by the icebreaker: "Got stuck in the ice, stop the machines". But the steamer could not cancel its momentum and kept approaching the icebreaker with a threatening speed.

Then a signal was issued by the icebreaker: "Full speed backward". And just the same in spite of the powerful stream of water coming from the propellers of the ice-breaker, which was meant to throw back the steamer "KUZ-NETSKSTROY" or at least to slow down its progress, the ship, being unable to cut itself into a solid edge of the channel's ice, hit the left stern part of the "ERMAK" in a sliding, however, heavsy blow. As a result of this the hull of the icebreaker suffered damage, while the ship itself had its anchor damaged, by having its blades broken. The anchor was suspended from the half forecastle and the external plating of the hull was crushed in the area of the half-forecastle.

Subsequently it was determined that at the time of the damage the junior assistant to the captain was on the commanding bridge of the "KUZNETSKSTROY", who by the reason of his lack of experience did not take in due time the proper measures for the slowing down of the speed and for stopping the ship.

If there is a reason to assume that it will be necessary to slow down or stop the progress of the ship, the captain of that ship must immediately warn of this, with the aid of the conventional signaling, the ship following it. At the same time the captains of each vessel must watch the ship following it and, if it begins to lag behind, notify the icebreaker immediately of this.

It is necessary to carefully watch the ship coming in the rear also for the reason that it may help to avert contusion. By establishing the dangerous approach of the rear vessel, the captain of the foregoing vessel may give within a short time full speed ahead. Even if he cannot move his vessel ahead in order to get away from the ship approaching it, then in all cases he can throw with a powerful stream of his propeller the bow of the following ship sideways and thus avert collision.

The commanding staff must be thoroughly familiarx with the signals used in the active Arctic navigation. The ship commanders who are not familiar, by heart, with the

ice signaling, must not be permitted to guide independently, without supervision, the ship during the conduction through the ice. All the captains of the ships conducted through the ice tracts must carefully listen to the signals of the icebreaker and other ships of the echelon, and repeat the signals of the vessels sailing right in front of it. This will indicate to the icebreaker that its signal has been taken for execution, and permit it to maneuver more quietly and with greater reliance.

It is especially important to repeat the signals at poor visibility, in the fog or at snowfall. The ships must repeat the signals in proper sequence, and in the order of their dispositions behind the leading icebreaker. At poor visibility the captain of the leading icebreaker will watch the position of the ships chiefly by their signals. If some ship stops to repeat the signals, the captain of the icebreaker assuming that it lags behind the limits of their audibility, must stop the whole echelon and wait for the oncoming of the vessel lagging behind or, simply go back in search of it.

When following the icebreaker in the ice channel, it is necessary for each ship to watch all the time the condition of the ice masses, since the sailing behind the icebreaker does not guarantee freedom from ice damage.

Without extreme need one should not come too close to the ice slabs. Some of them have far reaching underwater ridges, which cannot be seen from the bridge, but which can easily ram the underwater section of the hull, or knock off the blades of the propellers.

The icebreaker "F. LITKE" sailed in the Chukotskoe at high speed in the rarified ice two to three balls solid. The assistant watch officer suddenly spotted that a small ice slab had a conspicuous underwater abutment. The watch officer decided to stop the starboard engine, figuring that the icebreaker will be able to veer sufficiently to the right. However, this maneuver could not improve the situation and the ice abutment knocked one blade of the starboard screw off.

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One should be especially careful when sailing in the crushed ice. Large and solid slabs can get under the propellers and damage same as they pass alongside the hull. When noticing such an ice slab the captain of the ship must turn away from it the stern, by the shift of the rudder, or stop the engines long enough to have the ice slab move away from the stern.

A sharp turn can cause damage to the screw, for the stern may roll under its structure the ice slab, by this maneuver. When large ice slabs get under the stern of the ship one must bring the ship, by a timely move, to a stop.

One should be especially careful and watch the condition of the ice when backing up. The ice slabs sneak in such cases under the stern and both the screw and rudder can thus be injured. In general, one should back up during the operations in the ice only when there is no heavy ice under the stern or near it.

When the ship, under the stress of conditions of the course, has to strike the ice with its stern, one should cancel the momentum and move with the slow speed. Before backing, the rudder should be set in the position "Straight", in the opposite case the injury to the rudder of the ship or the winding of the rudder rod is almost inevitable.

If some vessel of the echelon got stuck in the ice, its captain must immediately signal "I got stuck in the ice", pleading thus with the icebreaker for assistance. However, the ice groups are only on rare occasions immobilized, and for this reason one should carefully watch their movements. As soon as conditions permit, one should continue the advance, by notifying of this turn the icebreaker and the other ships of the echelon with the signal "I am going forward".

When the beset vessel has to be scraped off, the captain of the latter must carefully watch the operation of the icebreaker in order to be sure that he did not pass up the favorable moment for advancement. If this moment is passed up the icebreaker will sail forward and toss the ice from its propellers, with which the ship can be pressed in again. The machinery of the ship must be kept in full ~~readi~~-

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readiness and give immediately full speed forward, since the stern of the icebreaker will pass only on the forward speed just to the middle or the bow part of the scraped off ship. If the scraping is taking place in heavy compact ice conditions it is advisable that the machines of the scraped-off vessel begin to move forward ahead of the above indicated moment. In such case behind the stern of the second vessel there is free water or fine crushed rarified ice, it is recommended to back up slightly, so far as possible, so that after the passing of the icebreaker carrying out the scraping operation there should be as little crushed ice as possible in front of the vessel.

When navigating in the ice-filled areas, it is very important to watch carefully the condition of the holds and water drains. No later than each hour on the hour, one should check and see whether water appeared in same and whether its level had not been raised, if the ship is not water tight.

Independently from these regular observations each time when the ship strikes against the ice, especially in the bow part of it, one should carry out additional investigations in the holds and the water channels. As soon as the water appears there or its level has risen, immediately one should find the place of damage and take measurements toward its elimination.

In the history of Arctic navigation cases are on record when because of insufficiently careful observation of the water level in the holds and drainage grooves proper measures had not been taken at the right time, and this led up to grave consequences. If we do not watch the drainage grooves, the sudden penetration of the water in the holds because of the ice injuries, can be detected only at the time where its elimination is already impossible. As a result of this the ship may sink near the icebreaker even though it has at its disposal powerful means for elimination of the water. If the penetration of water is detected in due time, the icebreaker can offer assistance to the ship or will take it in the port for repairs.

The captain of the vessel which went through any kind of damage which had caused the inflow of the water, must

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immediately report to the captain of the leading icebreaker with the signal semaphore or by radio.

In sailing through the ice grits or slush one should pay especial attention to the kingston valves. If they are packed with ice one can have the overheating and leak of the coolers. Therefore the kingston valves must be cleaned in proper time and the cooling units must be drained.

Regardless how the computation of the trip is made on board the icebreaker and the observation of the places in the echelon, and all the ships get from the icebreaker coordinates of the place where the ice conduction is terminated (if it is terminated at sea or in the conditions of poor visibility) the captain of each ship must figure in his own way the range of his trip. The place where the ice conduction is terminated, which the captain of the icebreaker reveals, is called the control place.

Cases are on record when a ship stuck in the ice and losing its contact with the echelon, could not communicate to the icebreaker its coordinates, which had greatly complicated its search.

The ice conduction both for the icebreaker and the guided ships is essentially a case of maneuvering in the most complicated, varied and unexpected conditions. For this reason one cannot recommend for each possible contingency an exhaustive set of advice. However, above we have analyzed the basic conditions for the safe sailing of the vessels behind the icebreaker. A strict observation of these conditions will contribute, to a high degree, to the success of convoying.

Section 37. Directing the Freight-Carrying Vessel While It Sails on Its Own Through the Ice.

An independent sailing of the freight-carrying ships in the ice condition is effected chiefly in the fall and spring seasons, and in the Polar Seas also in the summer-time. In doing so and by the measure of accumulation of the experience in navigation through the ice, and with the improvement of the ice service and weather service in connection with the use of the airplane reconnaissance of the ice masses and construction of solid vessels especially adjusted for Arctic navigation, the independent navigation of the freighters in the ice areas develops more and more effectively with each passing year.

When sailing in the ice conditions the delays cannot be avoided, and for this reason the supplies of groceries, lubricants, fuel must be increased by 20 to 30% over the ordinary supplies.

For sailing in the ice for a period of two to three months a four-months' food supply is considered normal. If one has reason to expect the possibility of wintering over in the ice, the supplies should be increased for another ten to twelve months, in addition. Quite recently the freight-carrying vessels, as a rule, are provided only with the current supply of groceries, while the winter supplies are being kept on board the icebreakers and are distributed to the ships as the occasion may arise.

Before the freight-carrying vessel is released for independent ice navigation the captain must obtain exhaustive information on the impending ice and synoptic situation in the navigational areas, as well as in the adjacent regions. In the process of navigation he must carefully study the actual situation and take note of all the changes deviating from the prognostication. To offer exhaustive indications bearing on the tactics of independent navigation of a freight-carrying ship in the ice conditions, in view of the complication and diversity of the situation is quite impossible. Here we shall present only the basic recommendations which the captain will find in the majority of cases useful in assisting him to find a get-away from

the adverse situation and to deliver his ship safely to the place of destination.

As the ship approaches the zone of the probable edge of the ice, especially in fog, snowfall or in poor visibility, it is necessary to reduce the speed to the lowest one and be ready to fully back up. The large tonnage and loaded ships are advised to lay on a drift course or cast anchor up to the improvement of visibility. In doing so one has to consider that as a rule the lee side edge of the ice is sharply bordering on clear water, and the weather side, on the contrary, is diffused and covered for a great distance with small debris of ice.

The selection of the easiest way to follow in the ice-locked areas depends upon a whole series of conditions and, in particular, upon the well organized observation on the condition of the ice. Observations made on the ice conditions, basically are made from an elevated spot of the vessel, from the upper bridge, from the mast top, from the crow's nest.

As the ship approaches the edge of the ice the captain from the mast top must carefully survey the expanse of the water covered with it, in order to select the place which is the most accessible for the entrance in the ice locked area.

In homogeneous ice masses it is the most advisable to select such places where the ice is most rarified or where cracks, puddles, tidal leads, shore leads, etc., can be spotted. Sometimes the tidal leads can be observed in the center of extensive fields or large debris of fields, alongside a fine crushed continuing ice of ten balls is located. In such a case it is not advisable to enter the tidal lead, since at the moment of the ice and compressures of same the ship can be damaged. In these conditions one should enter in the continuous, yet fine crushed ice.

If the ice is compact and clean then with certain experience one can dudge by its shade about its solidity

and select a position which is the most advantageous for entering the ice field.

One should remove in proper time the mechanical installations. Quite frequently it so happened that long time before the entrance in the ice, when coming across with the floating and poorly noticeable ice slabs the bottom installation was folded under the hull and came out of commission, while the rotator of the broadside was chipped off. Then all the water eliminating means should be made available and fully ready for operation, with preparation of the quick action cement, planks, cross-pieces and other means used in filling the breeches.

It is also advisable to have ready on the stern one or two ice anchors or kedge anchors, with attached coils of reliable steel cables, set up on the mast top an observation post with the most experienced signalmen. Their duty will be to continuously watch the condition of the ice cover along the course of the vessel and report on the results of their observation to the commanding bridge. It is most useful to establish a trim on the stern. This will reduce the risk of the breakage of the screws and rudder.

As the ship climbs on the surface of the ice one should pass the word into the engine room insisting on readiness to change the speed, and also to check on the condition of the kingston valves. In order to avoid injury to the front part of the ship, one must enter the ice with a slow speed, bringing the machines to a halt and proceeding only with the force of inertia, and only, upon entering the sea ice, to gradually increase the speed, in considering the solidity of the hull of the vessel and the condition of the ice.

One should enter the icefield as far as possible, under the right angle, in order to take the impact not with the cheek portion of the hull, but with its most solid part, - the stem. It is especially important when the edge of

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ice becomes solid and also when waves are coming from the side of the free water to the edge of the ice. In strong wind and heavy swell it is not recommended at all to enter the lee side edge of the heavy ice.

If there is no means of bypassing the ice and proceeding through free water or a weak ice, the captain must obtain reliable information on the fact that the ice is passable for his ship, and the impending weather forecast contains no threat of sharp deterioration of the ice situation.

At a visibility of five to six miles and a sufficient experience of the captain the condition of the ice can be correctly evaluated within the limits of up to ten cable lengths. At a distance of two to three miles from the ship even the rarified ice appears from the commanding bridge of the vessel, compact. The ice with its banks appears compact even from a shorter distance. From the top of the mast the range of the correct evaluation of the ice condition is increased ~~xxx~~ almost twice. For a more precise determination of the quality of the ice met with along the course, one should compare it with the ice properties of the one that had just been passed through, and is left behind the stern. A considerable accumulation of ice should be bypassed (preferably from the lee side).

It is advisable to have the freight-carrying vessels when sailing independently, run through shore leads and tidal leads. However navigation in the coastal tide leads and shore leads as it had been already said, is connected with hazards.

One should carefully consider all the important deviations of the ship from the port, so that one should not lose its general direction.

If the ship got stuck in the ice, but there is a basis for assumption that the impassable zone is not extensive, one may attempt to force it. For this purpose one should depart by back run to some distance from the obstacle

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(from one to two lengths of the vessel) and, setting the rudder forward, give the forward run, and attempt to overcome it with a short dash. If this fails to take effect or if the condition of the hull does not permit it to resort to such a move, one should look for a more passable ice. When moving backward one should direct the ship through the broken-up channel. In the case of single propeller ships the turn always tends to deviate in one or the other side, depending upon the turn of the screw. In this case one cannot operate with the rudder and it should be kept in a straight forward position.

When entering the ice field one should keep in mind that if the forcing of the ice will exceed the power of the machinery, one should move out from the ice with back runs. But to get out of the ice locked area sometimes it is very difficult, and one should not figure that when the rudder is set to the side, the ship can deploy for the reverse course and thus again come out to free water. A two-propeller ship can get out from the ice entourage easier than a single screw ship. The single propeller vessel, due to the tossing of the stern while backing out, and when the rudder is set straight, will at all times get pressed on one of the edges of the channel and finally it can get out from it and out in a new trace in the ice. For this reason the single propeller ships should be let out from the ice at a slow speed by taking into consideration that the maneuvering in the ice differs considerably from maneuvering in free water due to the quick "dimming" inertia of the vessel, absorbed by the resistance of the ice. The maneuverability of the vessel during operations in the ice is considerably reduced, while the diameter of circulation is increased.

Besides this, one should further stress that when a single propeller ship is removed from the ice entourage by backing, the rudder must at all times be kept in a straight position. Even at a slight deviation from the diametrical plane of the ship the injury of the rudder or the folding of the rudder rod cannot be avoided.

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By navigating independently in a shallow water area, it is necessary to increase the draft of the vessel to its maximum (fill in all the ballast tanks) and even to provide the trip on the bow. Then in case of grounding it will be sufficientix merely to pump out the ballast water from the bow tanks, and then the ship will, with the reverse movement get off the shoal, if the grounding took place from a slow speed run.

In order to keep the ship from going too far on the ground, the machinery as it proceeds along the shore, must operate at a slow speed or by jolts. One should use the full or medium speed ahead only for a very short time, upon which the machinery stops, and the ship will proceed by inertia. However, such a maneuver can be practically carried out on a short complicated sector of the trip.

However, if the complicated conditions of navigation and the rest of the ground of the vessel on a shallow place are possible on a considerable stretch of the course, also some other measures of precaution are being taken. In particular at the by-passing of the heavy ice fields by the coastal tide leads, sometimes the anchor is cast with a short length of the anchor chain. With the shallowing of the water the anchor will stick in the ground and thus it prevents from coming close to the bank.

At the present time this method is used on rare occasions. In the first place when coming across a bank or a steep precipice the ship may stay on its own anchor or have its hull injured. In the second place at the present almost all the ships sailing in the ice conditions are equipped with echo sound and at any ground, with the exception of the liquid silt (in which case the echo sound does not give precise indications), the ship's captain can get timely information about the decrease of the depth. Besides this the cast anchor and the anchor chain increase the resistance to the sailing of the ship, and to a certain degree, deteriorates its handiness.

The most complicated should be considered the ice

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masses without shore lead or tide lead in case of an independent sailing of a freight--carrying vessel. If the situation is complicated to that extent, that the ship without jolts and forcing of the ice is not in a position to move ahead, it is best to stop, lie on the drift and wait for improvement of the ice situation. The forcing of the considerable surfaces of the heavy ice is always connected, in the case of a freight carrying vessel, with the danger of the injury to the hull, excessive waste of the fuel and fresh water. One should back up to the distance of one or two lengths of the ship's hull and with full speed ahead break through the ice.

From the blows at the ice the rivets get loose and sometimes fall out, the seams pull apart, the plating of the hull is pressed in, the hull starts to take in water. From powerful blows and concussions the ships' mechanisms deteriorate, both the boilers and the navigation instruments. In no case should one break the ice banks with full speed. They should be bypassed under all circumstances.

It is not advisable to lead in the ice locked areas the unloaded freight-carrying vessel, since the propeller screws and the rudder are easily subjected to injury. Besides this the unloaded vessels are in possession of a small inertia, powerfully yaw at the wind and are steering badly.

On approaching another ship stuck in the ice, one should be exceptionally careful. If the ice around the standing vessel is broken up, then usually ice slabs are grouped around the side and at the impact with cheek against large ice mounds the approaching vessel will unexpectedly be dashed to the side. In order to avert damage in similar conditions one should approach the ice under an acute angle and possibly with a slow speed.

Section 39. Towing of the Vessels in the Ice Tracts.

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During its conduction through the ice the ship cannot always follow the icebreaker on its own power. That takes place in connection with the heavy ice situation, the drift of the ice masses or compression of the channel, laid out by the icebreaker, at the unsatisfactory tactical condition of the ship itself, in particular, insufficient power of its machines, weakness of the hull, rudder or propellers, the presence of ice injuries incurred during navigation, etc.

The shaving of the ice around the ship is not highly effective in such conditions, and frequently is conducive merely to the loss of time and the unproductive waste of fuel. Even though in the case of the icebreakers with a vessel in tow, the maneuvering and efficiency of the operation in the ice settings are sharply reduced.

However, there is no other way out, and the ship conducted through the ice masses must be taken in tow.

It has been said above that at the compression of the ice masses or at the passage through heavy ice and ice banks, when the channel laid out by the icebreaker is packed tight with the ice, the icebreaker must take each ship of the echelon in tow and lead them through short distances. The distance of such conduction in each particular case depends upon the ice situation that came into being. If the heavy ice masses continue through a long stretch, the icebreaker takes the vessels in tow for a distance of three to ten miles.

When the icebreaker tows the ships in a certain order through the heavy ice masses the towing of two ships will cause the icebreaker to spend two and one-half times as long as when taking in tow only one vessel. For conduction in tow of three vessels, the icebreaker has to use four times as much time as when conducting one vessel in tow. The conduction of ships in heavy sectors can be considerably expedited by an auxiliary icebreaker, sufficiently powerful for the job to overcome the ice and to tow the freight-carrying ships.

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In the ice crust of the autumn formation covering large areas of the sea, in favorable weather and at good visibility the towing of two vessels simultaneously is quite advisable, since it will expedite the conduction twice to two and one-half times in comparison with the towing of each single ship. In the ice crust conditions the icebreakdrs, in possession of a large reserve of power, can sustain equal sailing speed and straight-line run and in case of necessity, also to make diagonal turns.

For this reason simultaneous towing by the icebreaker of two ships is practiced in the ice conditions of the Bay of Finland, and in the other basins in those parts of the year when the expanse of the water is covered up with the ice crust type formation of ice.

But simultaneous towing of two ships by the icebreaker is not profitable in all codditions. So, for instance, in light and compact ice crust masses and in a gray young ice up to 15 cm thick the channel will promptly fill in after the icebreaker and the ships with weak machinery, cannot proceed. Thus the icebreaker was forced to take them in tow, one after the other, for five, ten to fifteen miles (depending on the drift of the ice and the specific situation).

For simultaneous towing of two well-built ships not over medium tonnage, while one of them (or both of them) must have the ballast. The length of the towing cable should not be in excess of 100 meters. For a better steering capacity the ballast vessel may be taken by the icebreaker at its stern dugout, however, not tooclose, but with a clearance of about 30 to 40 cm. The entailed ship is towed by a cable attached to the stern of the first ship to the bits or to some other parts. If at the end tail of the ship there is no towing cable, two steel 75 mm mooring cables can be used for towing.

The speed of the towing in ice varies and depends upon the quality of the ice and the method of towing. However, in the majority of cases it is not over six knots.

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The sailing speed at the simultaneous towing of two ships in the ice is usually four or five knots. The machines on the towed vessels must be in full readiness to give, by the first signal, the necessary speed promptly. When the cables are overstretched and when the threat of their shearing becomes evident, the ship works with its own machinery (according to the best judgment of the captain).

Sometimes simultaneous towing is practiced by the icebreaker of three non-automatically sailing barges. Such a towing is possible in compact, smooth and even ice crust conditions, up to 10 cm thick (if there is no pack, stratified ice which is formed during heavy wind from the shifting and climbing of the fields, one upon the other). The ships are overcoming the whole ice and are following the icebreaker outside of the line, if the channel is compressed by a strong lateral wind, forming the peaks of the dam, which is impassable for them.

In especially heavy ice conditions quite frequently the conduction of one vessel is practiced by two icebreakers. In this operation the wider and more powerful icebreaker lays the channel in the ice, and the second icebreaker takes the ship in tow by this channel.

The equipment of the icebreaker is adjusted for the towing of ships: all the icebreakers have the towing winches, bits, cables and other special equipment. On board the majority of heavy-duty icebreakers in the stern part of the ship especial swallow is cut out for the towing of the vessels at close range, together with solid fenders. As a rule, a powerful automatic towing winch of the icebreaker with one or two drums of varying diameters is placed on the stern part of the upper deck. As it had been stated above the automat of the towing winch during the towage in the ice, especially heavy variety of ice, is not used, since it was not calculated for powerful stretching and the jolts of the towing cables.

A steel towing cable of especial manufacture is wound on the drum of the winch. The thickness of the cable

depends upon the tension effort of the towing winch of the icebreaker. The most frequently steel cables are used on board the heavy-duty icebreakers, with a diameter of 150, 175 and 200 mm.

In the presence of the towing winch with two drums, the icebreaker is provided with two towing cables of varying sizes, in accordance with the drums of the winch. So, for instance, on board the icebreaker "SIBIRYAKOV" one drum is calculated for a towing cable with a diameter of 150 mm, and the other to that with a diameter of 200 mm. On small ships with a relatively light ice situation the thinner towing cable is handed over, while for a large-size ship in heavy ice conditions the larger diameter towing cable is used.

The towing in the ice conditions is possible on a cable over 50 meters long, on a cable shorter than 50 meters and tied closely to the stern swallow of the icebreaker.

The advantage of towing on a long cable consists in the fact that it reduces to a certain extent the danger of collision between the towed vessel and the icebreaker in case of a sudden stop of the latter. Besides this there is less danger that the ice blocks cast out with the propellers will come under the stern of the icebreaker causing damage to the hull of the towed vessel. The deficiency of the towing on a long cable is the increased resistance of the towed vessel since the channel laid out by the icebreaker is filled with debris of the ice. If the edges of the channel consist of the compact heavy ice, in which the freight-carrying vessel cannot enter, then in the case of a sudden stop of the icebreaker the contusion of the vessel is unavoidable. When towing in the ice setting on a long cable the yawing properties of the ship increase, it undergoes an impact with force against the edge of the channel and is subject to damage. Besides this the towing in the ice conditions on a long cable is exposed to the risk of the shearing of the cable (if it gets stuck in the ice).

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The towing on a long cable is applicable when there is no compression of the ice and the nature of the latter makes it possible for the ship to follow the icebreaker in a straight line channel, without sharp turns.

Practically the towing of the vessels on a long cable is effected only in rare cases: if as a result of the ice damage or other injuries the ship lost its capacity of following the icebreaker; if due to the insufficient power of the machines it cannot sail independently even in the weak, rarified ice. Then this method is used for pushing the ship through the heavy accumulations of ice on separate, relatively small sectors. Such a method of towing is used also in those cases when the icebreaker has no stern swallow for the conduction of the vessels in solid ice. In doing so one may figure that in case the speed of the icebreaker is reduced, the ice will hold back the towed vessel, and prevent it from coming to a blow and damage caused by collision. The towed vessel must, in such a condition, be steadily ready to give full speed backward in order to destroy one's own inertia in case of a sudden stopping of the icebreaker.

At the towing on a short cable the ship is exposed to greater danger of being subjected to the blows of the ice blocks, cast out by the propellers from under the stern of the icebreaker. When towed on a long cable this danger is less real. The speed of the towing on a short cable, as a rule, is somewhat greater than on a long cable. The captains of the icebreakers usually avoid towing on the short cable and resort to this method if it is necessary to lead the ship through a channel densely packed with ice, providing the tract of conduction through the ice is short.

The most widely practiced towing in the ice is one at close range. If the icebreaker has a good stern swallow (Figure 56), then with a successful coincidence of the height of the stern of the icebreaker with the bow section of the towed vessel, further at relatively small tonnage of the latter, and also at tightly selected boat slings and

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the tow rope, this method can be considered the best and the safest.

Figure 56. The stern swallow of the icebreaker.

The ship towed at a close interval, is subjected considerably less to the risk of suffering damage to the bow portion of the hull from the ice blocks cast off by the propellers of the icebreaker. The ice blocks from underneath the hull of the icebreaker and from under its propellers are cast along the sides of the towed vessel, frequently not even touching it.

However even this method of towing vessels in the ice has essential deficiencies, and is used for this reason only in extreme cases when there is no other possibility of conducting the vessel.

When towing the ships at close range (especially those overloaded and of great tonnage) the icebreaker loses its handiness, and the towed vessel itself loses its power of steering. The icebreaker at its trip through the ice locked areas frequently is exposed to yawing; at the slightest deviation from the course by the icebreaker the towed vessel becomes a huge rudder in regard to the icebreaker, which will considerably increase each such deviation, preventing the icebreaker to return to its proper course.

If the stern of the icebreaker is pushed off excessively from its course, the towed vessel may slide out from under the stern swallow of the icebreaker and, laying itself with its cheek against its rear quarters, can itself be damaged and cause damage to the icebreaker. This is the reason the towing at close range is usually executed successfully and for a relatively long period of time in the smooth ice, where the icebreaker is almost free from yawing, and also in the channel laid out in the heavy ice which makes

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the yawing of the icebreaker difficult.

The icebreakers marked by heavy tonnage and exceptional length have the best steering at the close range towing of the ships of medium tonnage. So, for instance, among the number of the Soviet icebreakers, the best steering capacity when towing the ships at close range have the icebreakers of the type "I. STALIN". The icebreakers of the type of "ERMAK" are being steered with more difficulty, while the icebreaker of the "LENIN" type is the worst. The smaller is the water displacement of the icebreaker, that much more difficult is for same to lay a straight line channel in the heavy ice masses. The icebreaker with a large water displacement, on the contrary, breaks through a straight line channel in the heavy ice, and consequently, it is exposed to yawing to a lesser degree.

The towing at close range of the large vessels, over the tonnage and length of the icebreaker, is very difficult and frequently impossible, since the icebreaker loses its steering capacity in this case. The lateral machines are not of assistance at all times; in spite of their work and effect of the rudder, the icebreaker will slide sideways. At intensive yawing of the icebreaker the stem of the towed vessel jumps out from the stern swallows, or, still staying in it, but having deployed under the angle of about 40° to the diametrical platform of the icebreaker, presses with great force the hull of the forecastle in the angle (rib) of the swallow and causes an injury to the icebreaker by having the plates broken through or cracked up (Figure 57).

<u>Figure 57</u>. Injury to the bow part of the hull of the vessel and the stern swallow at the towing by the icebreaker at close range.

Powerful yawing is taking place quite frequently in the fine - or coarse crushed compact ice; the icebreaker from the impact with the cheek against the ice, is tossed

sideways, while the towed vessel pushes it at that time and increases the yawing. The stem of the towed vessel may jump out from the stern swallow also in the moment of a sharp stopping of the icebreaker or slowing down of its speed.

When the icebreaker, in order to get off its place, has to reverse its speed, there is a danger of causing damage to the stem of the towed vessel against the stern swallow, and of the rudder and propeller - against the ice.

When the towing cable shears, and so also the slings, and if the towing cable is unreeled from the drum of the winch, to which it is ~~ax~~ attached, when being towed closely, damage to the bow part of the towed vessel and the stern part of the icebreaker, are also possible.

When towing closely, it is not always possible to effect a close touch of the stem of the vessel and the base of the icebreaker's stern swallow, especially in the case of the ships with heavy contour. Frequently between the buffer fender of the icebreaker and the stem of the ship being towed, there is a clearance of 30 - 40 cm which contributes to the yawing of the towed vessel.

In order to control the yawing of the icebreaker, it is necessary to operate almost without stop with the changing speeds of the machines. This calls for a considerable tension and effort on the part of the ship's crew, and especially on the part of the engineer's crew.

Sometimes for reducing the yawing of the icebreaker, resort is made to the assistance of the towed vessel, on which upon signal from the icebreaker the rudder is shifted to the required side. At this time the icebreaker keeps its work with its own machine. However, such an assistance usually is insufficient, its effectiveness is slight and does not produce any noticeable effect toward the correcting of the icebreaker's yawing.

When the ship is towed in the stern swallow of the

icebreaker as the result of yawing on the tow cable and tow winch considerably larger tensions originate than at towage on a long or short cable. For this reason quite often the winch does not hold out the stretching of the tow cable and arbitrarily drops it, in spite of the properly functioning stopping device. Therefore when towing at a close range, the tow winch should be assisted by some additional device, for instance, Bullivan stopper, etc.

One should not permit the towing of the vessel in the stern swallow of the icebreaker if the fenders of the towed vessel are below or above the stern deck of the icebreaker (Figure 59). This threatens with the shearing of the tow cable or slings led through the tow ear-ring of the icebreaker and the fenders of the towed vessel since the tow cable or slings operate in such a case for shearing, forming at the ring an angle up to 80°. Besides this in such conditions the towed vessel cannot reliably and firmly continue to stay in the stern swallow of the icebreaker and is jumping out even at the slightest yawing of the latter.

Figure 58: Disposition of the fenders of the towed vessel below the stern deck of the icebreaker.

Figure 59: Disposition of fenders of the towed vessel above the icebreaker's stern deck.

When towing the vessel in the stern swallow of the icebreaker in heavy ice conditions, which the icebreaker can overcome only with difficulty, the towed vessels upon the signal by the captain of the icebreaker gives its machine full speed forward, which frequently contributes quite positive results.

By far the worst situation develops when the icebreaker and the towed ship framed in its stern swallow, get stuck in heavy ice conditions. In order to get out from the predicament, both the icebreaker and the towed vessel must give full course backward. However when backing up the icebreaker presses hard with its stern against the stem of the towed vessel. In spite of the heavy buffer fenders, which are fixed in the swallow of the stern, the stem of the towed vessel can bend, while its rudder and propeller may break from pressure against the heavy ice under the stern. Such damage happened quite frequently in the practice of the Arctic navigation.

In order to avoid damage, whenever being pressed in such a position, it is most advisable to resort to the assistance of another icebreaker, even though it would be necessary to wait for it quite a while. If it is impossible to call out another icebreaker for assistance, one should try to get loose, by starting to work cautiously with the alternating runs of the machines, making an attempt to wash off the ice with a stream of water from the propeller of the icebreaker and the vessel, as the first move in the operation. If this does not help, it is necessary to drop the tow cable and the icebreaker should make an effort to advance without the towed vessel.

In compact, smooth, even surfaced ice locked areas 30 to 50 cm thick the icebreaker does not yaw, as a rule, and leaves behind it a straight line channel. In such conditions the icebreaker with the freight carrier towed in the stern swallow, proceeds almost in a straight line.

If the icebreakers, especially of the auxiliary and the port type, in which there is no stern swallow or the swallow is so small that the bow of the towed vessel cannot be taken in. In such case the towing at a close range is not advisable.

There is another method of towing the vessels by the icebreakers - pulling by the tow winch. This method is used when the icebreaker, upon forcing the ice banks or the

ice covered up with a layer of snow, packs the ice grit mass, mixed with snow, through which it can pass alone, but cannot guide through the ship. The pulling by means of the tow winch is resorted to also when one takes the ships through the embankments of heavy compact ice.

The icebreaker passes on the tow cable to the conducted vessel and, on its further trip, releases almost its full length from the winch. Stopping, thereafter, and staying on the same spot with the machines, the icebreaker operates with the tow winch and pulls behind it the conducted vessel, which gives full speed forward with its machinery, an aid to the tow winch and the icebreaker's machines.

The method of pulling the vessels with the aid of the tow winch cannot be used in cases when the ice is solidly packed in a great depth and when the icebreaker cannot push it apart on the sides. If the icebreaker, upon casting the towed cable and releasing it will proceed forward, between the conducted vessels and the icebreakers a solid ice cushion will form. It will not permit the icebreaker to pick up the tow cable and approach the ship even while all its machines are backing up with full speed. In the case of a heavy compression of the ice, or when a tortuous channel is left behind the icebreaker, the towing in the ice conditions is exceptionally difficult, and sometimes even impossible.

Both the icebreaker and the ships conducted by it, must at all times be ready for the towing. As we know the installations and supplies of the icebreaker provides for towing and is prepared for same. On the other hand the freight-carrying vessels conducted through ice fields, must get ready for a thorough and timely towing.

Before all, it is necessary to hoist the anchor on the deck. This should be done for the following reasons:

> independently from the towing the anchors may be injured by the underwater ice blocks and the ice masses which stand ribwise at the stem; gthis especially applies to the ships, on board which the fenders are fixed closely to the water line.

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the icebreaker upon approaching for the casting of the tow cable with its stern portion to the bow of the vessel, can easily injure the anchors and fenders of the latter and sustain injury to its own hull;

one should heave the anchors on the deck also in order to relieve the fenders under the towing slings.

On board the majority of ships navigating in the ice conditions, the heaving of the anchors to the decks is on its own merit a fairly complicated operation requiring considerable period of time. It is especially complicated when there is lumber and other cargo on the deck, which will interfere with the operation of the ship's arrow. In such cases the anchors are usually not stored on the deck, but are removed to the rear part of the forecastle and are fixed in such a position on a keel mooring cable. However, such a fixing of the anchors should not be recommended. By sticking out far all the sides of the hulls, they can be torn off in the ice or cause a serious injury to the hulls of both the vessel and the icebreaker.

The icebreaker "ERMAK" while engaged in the shifting of the vessels inside the port, was chipping off an old ship. The blade of the admiralty anchor which was stowed on the deck of the vessel, abutting out of the side, got hooked up with an open searchlight of the icebreaker. All the anchors and stoppers, the anchor chains of the windlass had been torn away and the anchor chain began to unwind. The icebreaker simply could not suppress the inertia, and dragged along the anchor chain with great force. As a result of this the side of the icebreaker got a two-meter long gash injury with the blade of the anchor. The unfolded three reels of the anchor chain sank to the bottom, and did not hit the right-hand side screw by sheer accident. And the screw all this time was working with full speed.

We can quite another example. The icebreaker "ERMAK" was conducting the fully loaded steamship "KUZNETSKSTROY" through the ice. On board the steamer the anchors were

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stretched to the rear part of the forecastle and were hanging on the guides attached to its blades. During the periods of ice shaving the icebreaker was pushed against the ship and the anchor was torn off. Only the spindle was left which hung under the fender on the anchor chain. In addition, also the icebreaker and the ship were damaged.

One should not leave the anchors in the fenders, either. The anchor located in the fenders prevents the icebreaker to approach the bow part of the vessel in order to cast over the tow cable, and also to perform the ice-shaving operations.

In order to place the anchor promptly on the deck, it is necessary even before setting out to active Arctic navigation, to be sure that the anchor brackets (if they are not screwed) are well manageable and can be easily moved. Otherwise it will not be possible to promptly free the anchor from the anchor chain. In order to free the fender of the anchor chain, it should be released to such an extent that the anchor brackets should drop out of it. Therefore they attach one end of the steel cable to the bit, while the other end is threaded through the brackets of the anchor. It will be turned backward through the flank of the bow of the ship and attached it to a bit. After this they again release the anchor chain, and when it is sufficiently loose, they lower behind the side of the storm trap or suspension weight, from which they release the bracket connecting the anchor with the chain.

In order to avoid dropping the bracket overboard, it is advisable to attach it with a thin line before the operation starts. Behind the anchor they fix the gasket, and placing on it the hook of the loading arrow, they raise the anchor on the desk. If the ice is strong, one can advise to drop the anchor on the ice while attached to the rope of the loading derrick. When the ship moves forward, the anchor will be under the loading derrick and it will be easier to raise it on the deck.

On the bow of the vessel one has to prepare a sufficient number of the casting ends and steel cables for the

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reception of the towing cables from the icebreaker. Depending upon the method of towing the cable from the icebreaker may be delivered either with a special bracket or with a bracket and a block of the Nikolaev system. In the first place one should free the fenders of the anchors and anchor chains ahead of the time and lead through the fender the steel cables in order to pass forward the tow rope. The end of the cable with the thumb knot is passed through the hawse hole and raised to the deck (in some cases provided with a block); and the other end should be wound with one or two turns on the drum of the windlass.

When the stern of the icebreaker comes close to the bow of the ship they cast from the icebreaker the throwing end of the cable for the reception of the conductor cable. On the ship the conductor cable is attached with a bracket to the strop, after which it is stretched in, with the aid of the windlass, in the fender up to the drum of the windlass where it is taken up to the bull stopper, while the end of the internal side is passed on to the other fender. Both knots of the strop from the external side of the fenders are raised to the deck, their ends evened out and attached, with large brackets, to the towing cable, which is fixed to the pivot of the bracket. In doing so one should see that the towing rope, cast from the icebreaker, can be dropped promptly and easily. For this reason on one of the knots of the strop a steel conductor cable is left, which is loosely attached to a bit. In case it becomes imperative to drop the towing rope the bracket with the block is raised to the deck with the aid of a conductor cable.

There is also another, more rational method of attaching the towing cable. The strop is passed through the towing block, both ends of the strop are simultaneously stretched by the conductors in the fenders. On the deck the knots of the strop are tied among themselves by several turns of a strong vegetation rope (Figure 60). In order to drop the towing cable with such a method of attachment, it is sufficient to untie or cut through a manila rope connecting the knots of the strop.

Figure 60. Diagram of attachment of the brackets of the towing rope with the hemp flappings.

There are also other methods of attachment of the towing strop, so inserted for instance, with the aid of a beam led through the knots (Figure 61) or of the large bracket. However, one should not recommend these methods since from the excessive stretching of the towing cables the ends of the strop cut in the log, and the bracket can lost its shape.

Figure 61. Diagram of fixing of the strops of the towing vessel with a log.

Due to the yawing characteristics of the icebreaker, the ends of the towing strop reinforced with manila rope, passing in the fenders of the towed vessel, are exposed to intense friction, are rubbed up fast and are torn quite frequently. The new installation of the strop requires the stopping of the movement and a great loss of time. At the present time on board the icebreakers they frequently practice the more peffected method of connecting the tug with the towing strop. In place of the bracket connecting the end of the towing cable with the ends of the towing strop a steel block (of the Nikolaev system) is used, through the pulley of which the towing strop passes (Figure 62). Owing to such arrangement the ends of the strop passing through the fenders of the towed vessel, are continuously in an immobile state, while at the turns of the stern of the icebreakers, the center of the strop is shifted by a pulley. With this also the uniformity of the stretching on the ends of the strop is secured.

Figure 62. The steel block of the Nikolaev system.

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/Top - View from above /Middle - Blocks.
/Right - View from side.

On board the vessel one should prepare a towing strop ahead of the time, as it passes to the side of the ship through the fenders, if the towing cable is cast from the icebreaker with an especial strop or if one prepares a mooring neck.

On small freight-carrying vessels towed by powerful heavy-duty icebreakers in heavy ice conditions, the mooring can be wound around the entire hull of the ship, around the superstructures of the deck, around the masts and bits, around the comings of the holds and around other reliable objects.

When installing the moorning one must see that it should not be shorn at sharp angles of the tanks. One should not permit the attachment of the towing cable to the mooring bits of the vessel as well as to the windlass, since such an attachment during towage in the ice conditions ends almost always with damage: the bits are cut or turned out, the windlass breaks or is torn off its foundation.

When towing the vessel in rarified ice masses or in free water on a long towing cable the attachment of the latter is somewhat easier: it can be attached to the anchor chain or to both anchor chains of the ships. In doing so the stretching of the anchor chain must be picked up not by the windlass, but by solid stoppers, especially inserted in front of the windlass. In order to increase the resiliency of the towing cable and in order to have it absorb more easily the jolts at the change of the sailing speed, from the towed vessel sometimes two or three lengths of the anchor chains are dropped.

When towing in the ice conditions in order to weigh the towing tackle the anchor chain is not dropped and no weights are used since at the submersion of the towing

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cable under the ice there is a considerable increase of friction. In addition when turning over the ice slabs that float against it, the towing cable is acting as a spring and emerges to the surface with great jolts.

In light ice conditions one can attach to the towing cable as cast from the icebreaker, also one's own reliable cable. When engaging in towage in such conditions by the present-day icebreakers equipped with automatic winches, one should not fear powerful jolts, since the winch automatically drops the cable at its intense stretching and picks it up when the cable slackens.

In heavy ice conditions the automats of the towing winch, as a rule, is not used since at intense irregular stretching of the cable the automat holds it insecurely and may drop it altogether.

When towing in the ice conditions it is possible at all times that the ships touch each other and the damage to their hulls caused in consequence, makes it necessary to keep both on board the vessel and the icebreaker a considerable quantity of soft fenders in readiness. If the ship does not have the necessary fenders, one should prepare the rolls of the vegetable or steel cables. The steel cable protects better the hull of the vessel from the blow than the hemp rope, a turn of which can be easily cut through with the stem, or by some other abutting part of the hull. However, the steel cable weighs considerably more than the hemp rope and it is much more difficult to operate with a fender from the steel cables.

When towing the vessels at close range the towing cable is attached to the strop led through the fenders of the towed vessel and is picked up by the winch stretched out, until the stem of the vessel is pressed to the fenders fixed in the stern swallow of the icebreaker. After this the towing cable is pressed down by the friction stopper ar is reinforced by the chain stoppers. Besides this the bow part of the towed vessel is additionally reinforced in the stern swallow of the icebreaker by two additional reliable steel wire hawsers or, in rare cases,

with the anchor chains supplied to the ship cross-wise.

The clearance between the cheeks of a vessel and the fenders of the stern swallow of the icebreaker are filled with additional suspended fenders.

When towing in the stern swallow of the icebreaker one should not tightly press the ~~stem of the vessel to~~ the fenders of the stern swallow of the icebreaker. When towing large, heavily laden ships, and also at yawing of the icebreaker at a close connection of the two, huge tension is laid on the towing cable. If in addition, there is no reliable stopper device to assist the towing winch, the winch will not hold and the towing cable is dropped; besides this the handiness of the icebreakers also deteriorated.

The icebreaker, as is known, has a great mass and cannot suddenly cancel out its inertia momentum. Before it will come to a standstill the entire towing cable may be unwound and dropped from the winch.

In order to reduce the tension of the towing cable, to reduce the effort passed on to the towing winch, and to improve the handiness of the icebreaker during the towage of large heavily laden ships, between the stem and the towing fender in the stern swallow of the icebreaker, a clearance of 30 - 40 cm is left.

The success of towing by the icebreakers depends not only on their power capacity, condition of the ice masses, on the degree of loading with freight, or the tonnage and on the properties of the conducted vessel, but also, to a certain degree, on the character and reliability of the towing installation and the adjustment of the icebreakers for towage. Thus, for instance, the icebreaker "KRASIN" without the advantage of the stern swallow for the towing of the vessel, and also a powerful and strong towing winch, was handicapped in its towing operations of the vessels in the ice-locked areas of the Bay of Finland, considerably worse than other heavy-duty icebreakers, provided with a stern swallow and reliable towing winches.

The casting of the towing rope from the icebreaker to the towed vessel and its fixation, depending upon the conditions and work habits of the crew, preparation of the ships for towing, takes from five to thirty minutes.

If the icebreaker must frequently tow various ships in a variety of conditions and situations, the crew is usually well trained, possesses work habits with the towing cables and their delivery on board the ships. Without definite habits the fixing of the cable may become unreliable. Cases are on record when a tow line, cast from on board the icebreaker, was used on board the ship for two or three hours, and then even at the slightest tension the reinforcement shore.

One should note that the methods of installation of the towing cable as practiced at the present time and as described above, have become obsolete to a certain degree and are insufficiently perfected. They take too much time and require a considerable expenditure of cables.

Installation of the towing cables with blocks, metallic rods, etc., is very inconvenient. Besides this at such installations one cannot promptly drop the tow line. At the present time, in connection with the development of the mass construction of ships in the ice conditions and the towage connected therewith, the problem came up how to work out the new method of reinforcing the tow cable. These methods must secure the quick and reliable attachment of the cables and their instantaneous dropping.

When the strops are installed, the icebreaker, depending upon the method of towing, selects or drops the towing cable with the aid of the towing winch and begins to move slowly. While this operation is on, it is not possible to move the ship from the spot at all times and the icebreaker must do a lot of shaving for the start. For this purpose it passes along the weather side of the ship from the bow to the stern and, upon its return to the bow portion, casts the towing cable. If this does not manage to free the ship, the icebreaker repeats its maneuver the closest possible to the side of the ship, from which the

ice is being chipped off.

If the vessel which the icebreaker takes in tow, is not compressed with the ice masses too heavily and if the accumulation of the ice masses takes place chiefly at the bow portion of the ship, the shaving process can be replaced with washing off. The icebreaker approaches with its stern the bow part of the ship and casts the towing cable. After the cable had been secured, the icebreaker begins to gradually increasd the number of revolutions of the screws, paying out at the same time the towing cable.

As soon as the icebreaker makes the ship move, it starts to have its machines reverse the course, by shortening the towing cable. This maneuver is repeated as many times as will be necessary to have the bow part of the vessel free with the water stream coming from the propellers of the icebreaker.

The ice being removed with the stream coming from the icebreaker's screws, passes along the sides of the ship behind the stern of the latter. If along the sides of the ship and under its stern the ice is tightly packed, the stream from the icebreaker's screws will still better pack the ice, which will make the situation doubly difficult. In such cases one should shave off the ice by passing along the sides of the vessel.

When towing the ship in the ice conditions the icebreaker must move ahead on an even course, since sharp jolts cause the tering of the strops or of the tow cable. To deploy the ships with weak hulls is not advisable while towing them in heavy ice masses. This work is carried out with the aid of the auxiliary icebreakers. Sometimes in the absence of the auxiliary icebreakers and their insufficient power capacity, the heavy-duty icebreakers in possession of good maneuvering properties, deploy themselves the ships in the ice tracts.

The work spent on the deployment of ships, especially in heavy ice conditions and narrow space of the port basins, is fairly complicated and ti e consuming. Sometimes several

icebreakers deploy one single ship. The icebreakers themselves have to deploy quite frequently. When freely maneuvering and in the presence of good maneuvering properties, such an operation does not take much time: the average duration of deployment in the ice conditions for the reverse course takes ten to fifteen minutes for the icebreakers, and in narrow space of the port basins it takes up to thirty minutes, and more.

If on the towed vessel the machine and screws are in good condition, then by the signal from the icebreaker the towed vessel takes the course forward, however only after the towing cable, stops or the encircling moorings or the gripes are properly stretched. When towing at close range in heavy ice conditions the vessel in tow may, upon the signal from the icebreaker, proceed with full speed ahead; in this case the power of its machinery is almost entirely communicated to the icebreaker and increases the tension and speed of advancement.

In various hummocky ice varieties, where frequently the icebreaker may get stuck in, the sharp change of the sailing speed or the full stopping, the machines of the towed vessels in protection from contusion, take the reverse run. In this case one should be especially careful since at the reverse movement of the machines, when the icebreaker will again start forward, the shearing of the towing cable could not be avoided.

In the majority of cases at the towage by the icebreaker on a shortcable, the machines of the towed vessel continue to work, which will secure a great speed of movement for the icebreaker, and will considerably reduce the tension of the towing cable. If the icebreaker gets stuck frequently in the ice or when the propellers of the towed vessel are threatened with ice injury, they are given a small number of rotations. Only in exceptional cases towing goes on while the machine of the towed vessel is stopped. However in all conditions the machine of the vessel being towed must be prepared and ready for action as soon as the captain of the icebreaker requires it.

Section 39. Anchorage of the Vessels in the Ice Conditions.

While sailing in ice conditions the necessity to anchor arises quite frequently. In such cases it is advisable to get the vessel in the ice, and, should conditions permit, stop over without anchor. If this is impossible for some reason, it is advisable to secure the moorings by the stranded hummock, or a hummocky solid accumulation of the ice masses, and in the absence of a proper stranded hummock or a solid accumulation of the ice slabs, one should cast an ice anchor.

As a preliminary move one should carefully study the surrounding situation and select a large strong ice mass which not only can reliably hold the ship, but itself is a good protection from the drifting ice. Having selected the right ice mound, one should find out from which of its sides the ice is kept longer and where the free water forms. The ship is stationed around this place and one proceeds to the securing of the ice anchor. It is advisable to attach to its brackets a steel cable, then the anchor is dropped overboard and taken to the assigned place. They cut out a small hole in the ice and drop in it the blade of the anchor, after which they stretch the cable tight. If there is in the ice a natural hole or crack one can secure the anchor in same, however being fully convinced that it cannot become compressed. To cut out the anchor from a compressed crack is a considerably more complicated job than to cut it out from an ice hole.

All this time while the ship is anchored on an icy anchorage, one should watch without interruption the surrounding ice and that ice mound on which the anchor is secured. If the ice begins to become more solid around the ship, one should immediately raise the anchor and proceed to a more rarified ice tract, where one should select another convenient ice mound and secure the anchor on same. Usually when stationed on an ice anchor, such

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shifts from one place to another are unavoidable, since the ice situation changes rather rapidly.

The stationing of the vessel in the ice on a steady anchor, as a rule, is not advised. However, in practice there are such cases when it was impossible to avoid the situation wherein the anchor had to be cast. Such circumstances come to pass at loading and unloading of the vessel on the roadstead which had not been fully cleared of the ice, while waiting for the time to enter the port, etc.

The possibility of the ship's anchorage on a bower anchor in the ice masses is determined with the compactness, thickness and solidity of the ice and also by the speed of its drifting. Before all, the vessels must cast anchor in basins covered with a fine young ice or large crushed ice. The top limit for stationing the freight carriers of the ice class, can be considered the fine crushed ice with a compactness of four to five balls at a relatively low drift.

When standing on anchor one must be alert to the drift of the ice. Carefully watching the ice drift, the machine, the rudder installation and the windlass must be permanently prepared to take the ship off the anchor any minute or at least, by maneuvering the machinery, prevent the anchor chain from breaking. When anchoring in the ice area one should not drop the anchor chain to a great length. One should drop it not any longer than 1-1/2 to 2 depths of the place. In the case of the ice pressure the anchor chain will not be injured, it will be promptly pulled out, or the ship will drift under the effect of the anchor's drifting.

In one of the straits during the drift of the large and finely-crushed ice of four balls with a speed of about three knots, the ice cutting steamer "SIBIRYAKOV" and the icebreaker "KRASIN" were anchored. The steamer "SIBIRYAKOV" released eight lengths of the anchor chain and the entire anchor chain was torn off by the drifting ice masses. The icebreaker "KRASIN" released the anchor chain to 1-1/2 times the depth of the place, and in order to avoid the on-

rush of heavy ice masses, was further running the machines. As a result of these actions it kept ~~us~~ staying on safely in the same conditions.

If the ice strikes against the anchor chain it is advised to free it from ice by paying out or bowsing the chain, making it sure not to damage the anchor. If during the process of paying out and bowsing of the anchor chain it will not get rid of the ice, one must attempt to push it off with the stem by giving it a forward run with the machines and by setting the rudder in the direction of the anchor chain, and even if this will not help, one should raise the anchor and after the passing of the heavy ice-drop it again.

When large fields or huge masses of the heavy crushed ice approach the ship, one should immediately raise the anchor without waiting that these ice masses run against the ship and tear off the anchor chain.

Anchorage at the coast in shallow water is easier than in a deep place, but it requires much attention and is more hazardous especially when the wind comes from the sea. When selecting the place for anchorage one should, so far as possible, utilize any protection from the drifting ice - a cape, a heavy stranded hummock, etc.

It is not advisable to cast anchor for spending the night in shallow water, for at night it is not difficult to pass up the dangerous moment and to take timely, yet necessary measures, which can lead up to damage and even disaster of the ship.

It is not advisable even to station at bower anchor or ice anchor at the lee side of the solid shore lead while solid ice fields are under the effect of the wind. Infrequently large fields of solid ice come close to the shore lead and press against it, or which is still worse, drift at the shore ice.

In cases when the ship stationing on a bower anchor,

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is compressed between the drifting solid ice and the shore lead, tearing of the anchor chain and the loss of the anchor are the best expected results of the situation. More frequently such a condition ends with serious damage to the hull, or even with the loss of the ship.

If one cannot avoid settling on a bower anchor or ice anchor at the shore ice, one must keep the machine and the rudder installation fully prepared, and also set up a very careful and uninterrupted observation for the growth, reshaping and movement of the ice masses, with the change of the direction as well as the force of the wind and the currents.

In the practice of winter navigation cases are on record when a ship was anchored in free water or in the ice of insignificant thickness, and a few days thereafter was in the predicament of a difficult situation, since the captain of the ship failed to organize the observation service of the ice movements.

A case is on record when the ship anchored in a bay protected from the winds and covered with a young ice 2 - 3 cm thick, which it could quite naturally overcome easily; the anchor chain was dropped to a double depth. The next morning the temperature of the air dropped considerably and an intense ice formation started, to which the captain of the ship did not attach any special significance. On the third day the thickness of the ice rose up to 10 cm. Under the effect of the pressure wind the bay began to fill up with ice coming from the sea. At first the ice broke up and passed along the sides of the vessel. Then when a great accumulation of ice took place the anchor was lost and the ship began to drift rapidly toward the shore.

The attempt to tauten the anchor was not crowned with success, since the windlass could not overcome the forces of the ice pressure. The operations with the machine plant for a full speed ahead could not stop the drifting of the vessel.

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The compact ice was tightly pressed against the ship, while the anchor chain was stretched out. The captain commanded to shorten the anchor chain rapidly and to reverse the ship's course. Under the effect of this maneuver the stem of the ship was relieved of ice for a distance of fifteen to twenty meters. The ship assumed the movement forward, the ice began to crumble, the anchor finally was tautened and by machine plant maneuvering, the ship had been taken out from the bay. The success of the maneuver can be explained only by the weakening or the stopping of the ice drift.

In a contrary case it was quite impossible to free the vessel; by the process of its movement backward, the ice would advance right in the wake of the vessel, and would keep locking it indefinitelxy as before. This would merely expedite the ship's movement backward and its final grounding on a coastal shoal.

Let us refer to still another example. In late fall a vessel of great tonnage was anchored in one of the open sea roadsteads. The anchor chain was dropped to the double depth of the anchorage. As a result of a sharp drop of the temperature an intensive ice formation began and its thickness reached 5 cm.

Under the effect of the drifting ice and the wind from the seacoast of six-ball force, the vessel began to yaw, the anchor chain went through sharp jolts and periodically shortened since the stopper could not stand the tension. The captain of the ship, figuring that he is under the protection of the coast (even though the ship was at a distance of two to three miles from the coast) and could resist the elements until the ximprovement of the situation, ordered to still more tightly press the stopper. The boatswain did not figure that at a low temperature the metal becames brittle, and that it could crack under the blows, and began to press in the stopper with a sledge hammer. At the last blow, the handle of the stopper broke. The anchor chain ceased to shorten and consequently lost its capacity to suppress the jolts and

the yawing of the ship. Soon under the effect of the wind, current and pressure of the drifting ice, the anchor chain broke at the haws and was lost, together with the anchor. The captain had great difficulty in taking the vessel to sea.

From the examples specified above we can see how important it is during the stay at anchorage to follow and watch carefully the process of ice formation.

Section 40. Releasing the Ship from the Wedged-in Condition.

It has already been stated above that the ships wedged in the ice are being freed by the icebreaker during the period of conduction by the process of shaving. However, when sailing in the ice even the icebreaker herself can get wedged in, and the freight-carrying vessel can undergo the same fate in its atonomous, independent sailing. In this case the ship must free itself on its own, which requires a considerably greater waste of time.

At first one has to reverse the run at high speed. If this does not happen one must change several times the direction of the work of the machine by giving it slow or medium speed forward, then the full speed backward. If the ship, nevertheless, fails to get free, one should change the rudder from side to side, while the machine plant goes forward with full speed. A double propellered ship must operate intermittently with one propeller and full speed ahead, and with the other, full speed backward.

If even this does not help any, it is necessary, providing listing tanks are available, to transfuse the water or the liquid fuel from one side to the other, and

in the presence of the trimming tanks, one must pump the water from the bow to the stern, or at first from the stern to the bow in order to provide pressure upon the ice and then in the stern, with full speed backward. The trimming is preferable in relatively few cases, when the ship jumps high upon the surface of the ice.

In especially difficult cases of wedged-in ships in the ice conditions, the ice is being blasted with ammonal in order to free the ship. In the extreme case when small ships are wedged in in the young ice masses, the wedged-in part of the ship is shaved with crowbars. In order to get a ship out of the wedged-in condition it is the best policy to resort to an ice anchor or a small regular ice hook. The ice anchor or hook is placed behind the stern (Figure 63) or by the bow (Figure 64) of the stuck-in ship. Following this a small hole is cut out in the ice and the anchor is hooked to it by way of a horn. When shortening the tow rope attached to the bracket of the ice hook or ice anchor, with the ship's winch or stern windlass and by having the machines give full speed backward one can figure that the ship will start in the opposite direction and thus be freed from being wedged-in.

Figure 63. Freeing of the vessel pressed in the ice masses with the aid of an ice anchor laid at the bow.

Figure 64. Freeing of a ship compressed in the ice with the aid of an ice anchor cast from the side of the stern.

Under all circumstances the freeing of the ship from wedge-in is the most effective when carried out in the above described way. In the practice of active Arctic navigation there were numerous cases when not only the

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freight-carrying vessels, but even the icebreaker could not get rid of wedge-in even after a prolonged work with machinery, the trimming and listing transfusions. But all they had to do is to get equipped with ice anchors and begin to lay them out, as the ship became free even at a slight tension of the mooring cables secured by the ice anchor.

Section 41. Struggle with the Icing of the Ships.

Getting into stormy weather at subzero temperatures creates a condition for the icing of the ship. The hull, the upper deck, the superstructures, the mast, the bridges, the lifeboats and all the other installations set up outside, will soon become covered with a layer of ice (Figure 65).

Figure 65. A ship covered with ice during its sailing course in the Okhotskaya Sea.

At heavy surf the sides, decks and the hatches of the ship are covered with ice (Figure 66).

Figure 66. The ship, the deck and the sides of which are covered with ice following its towing in the sea at the time of swell.

In the low subzero temperature the water splashing on the deck of the ship, in a relatively short time, forms large masses of ice even on quite small surfaces (Figure 67).

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Figure 67. Formation of ice on two jackstays stretched along the sides of the ship.

The icing of the ship is very dangerous and if timely and effective measures are not taken, the ship may capsize. Under the weight of the accumulation of the ice masses the bow of the ship gets a deep draft, the propellers are laid bare and the ship ceases to answer the movements of the rudder. Besides this the ship begins to lose its stability because of the increase of the center of gravity. As a result of this the critical moment sets in and the ship may overturn.

The icebreakers and ships adjusted for navigation in the ice conditions are less subject to icing than the other vessels since by having a sharp violent rolling at a high stability, they sooner cast off the water which got on the deck. The vessels in position of a lesser stability, are subjected to icing to a higher degree.

If the danger of icing takes place one must take off from the deck all the guys, haliyards, lines, mooring and towing cables and all the other objects which may retain the water. It is necessary to check most carefully the reliability of securing the hatch tarpaulins, the freight and bunker holds, lifeboats, etc. Above the tarpaulins one should place planks from which it is easier to chip off the ice. All the deck mechanisms and in the first place the windlass must be covered with tarpaulin cases.

It is advisable to prepare the hoses for the sliding off of the iced sections of the ship with hot water, ahead of the time. Besides this, one should be sure to have the whole ship crew provided with crowbars and heavy hatches for shaving off since at the prospect of the threatening icing usually "all hands on deck" command is issued, and the entire ship crew is engaged in the struggle with the ice, with the exception of the watch on the commander's

bridge, the personnel in the engine room and the firing room. In order to avoid the freezing of the steam and water piping passing over the deck, and also of the steam mechanisms installed on the deck, their cylinders and steam conduits are freed from the water in a timely move, and are blown through. Those mechanisms on the deck which cannot be stopped, are engaged for a continuing operation at slow speed.

One must start the active struggle with the ice immediately, as soon as it begins to accumulate. If we pass up the first moment, the struggle will be exceptionally complicated, since the ice layer is increasing rapidly.

Before all one has to wash off the ice with hot water from the hose. If this does not give proper results, one should immediately start chipping off of the ice with hatches, crowbars and heavy cutting bars. As soon as the conditions will permit, one should reduce the sailing speed to the minimum, and drift so as to have the penetration of the water on deck in lesser quantity, and consequently formation of the ice will be sharply reduced. In this case when the ice was formed from one side, which will cause list, one may, the navigational circumstances permitting, change the course, so that the icing may begin from the other side and carry out the ice chipping work from the weather side.

One should never try to chip off the ice from the weather side of the ship during a storm, since that can cause accidents to the workers.

Before chipping of the ice is started, it is necessary to lay along the deck and places of work a sufficient number of reliable jackstays. When the ship rolls men will slip on the frozen deck - they fall and cannot hold on to objects covered with ice. On board the ships with dead gunwales especially attention should be give first to the deck porticos in the gunwales. Since the scupper pipes for the draining of the water flooding the deck, get rapidly packed with ice, the covers of the porticos may

freeze onto the hull; it is advisable to remove them ahead of the time or to tie them up in an open upper position.

The chipping of the ice on the deck should be started from the porticos and scupper pipes so as to secure the soonest possible repelling of the water overboard.

Section 42. Unloading of the Freight on the Ice.

In some cases in the ice conditions the roadstead vessels cannot in the open points come close to the poft and the freight has to be unloaded on the shore or fast ice, or to lead from same. Before the unloading of the freight on the fast ice one must determine the solidity of the ice, ascertain that it will not bend under the weight of the load and that it will not be torn off from the shore and carried in the sea.

After surveying the ice from the side of the sea or from the shore, and gaining a conviction as the result of the external inspection of the fact that its solidity does not cause any suspicion, they check on its depth. Depending upon the draft of the vessel, nature of the ground, the presence and nature of the waving, it is determined whether one can approach the fast ice for the purpose of unloading.

However, to determine the solidity of the ice by its external appearance, especially when it is covered with snow, is very difficult. Sometimes even experienced ship captains become subject to considerable errors. So, for instance, during the chipping off procedure of the icebreaker "KAPITAN BELOUSOV", the captain of the icebreaker "KRASIN" found, through experience that the ice is almost impassable and gave it full speed ahead. However the ice was

considerably weaker than the captain of the icebreaker "KRASIN" assumed, and his icebreaker being unable to suppress the inertia, hit the cheek portion of the above surface side of the icebreaker "KAPITAN BELOUSOV".

Sometimes it is quite impossible to determine with the bare eye the nature and solidity of an expanding flat smooth ice cover with a layer of snow. Therefore the solidity of the ice in practice is tested with the stem of the ship by cutting in at full speed as deeply as possible in the ice mass. If the ice stops the ship, especially with a powerful engine action and the bow of the icebreaker formation this is a sufficiently reliable sign of the fact that the ice will hold out with the load.

When unloading ~~on the~~ ice one should under no circumstances store the freight by concentrating the loading on one place. After the ship winches drop one lift on the ice, for the second lift one should remove the loads as far away as possible. For this purpose it is advisable to utilize the sleds with wide runners.

If the distance from the edge of the ice to the shore is not great, it is advisable to shift the loads immediately on the ~~x~~shore, by organizing the process in such a way that the shipment of the freight on the shore would not delay the unloading of the ship. In that case when for some reasons they begin to carry away the loads from the unloading place or concentrate it on a considerable distance is not possible, and also when the heavy loads are removed from the ship, they should be placed on wooden platforms.

CHAPTER IX

BLASTING OPERATIONS WHEN SAILING IN ICE CONDITIONS

Section 43. General Statements.

The blasting operations in the Arctic navigation are used for destruction of the ice dams and individual icebergs when forcing the ice-bound areas, at the schipping off of the ice from the sides of the vessel which was wedged in the ice, for protection of the ship hull from injury during the time of compression, and also for destruction of a solid coastal fast ice. In the practice of navigating in the ice conditions the ice is being blasted only in exceptionally difficult conditions, when all the other methods of its forcing fail to give positive results.

The success of the blasting operations in the Arctic navigation depends upon a number of factors: the weight of the charge, its shell, selection of the place where the charge was set up, the depth of dipping the charge under the ice cover, the appearance and thickness of the ice, its temperature, salinity, the nature of the mutual disposition of separate ice mounds and in general upon the surrounding ice situations. The efficiency of the blasting operations depends also upon the hydrometeorological conditions, in connection with which at the setting of the charge one must take into consideration the currents, especially tide and ebb currents, with the charge of which the periodical compression and rarification of the ice masses take place.

Each vessel which sets out for sailing in the ice conditions must be provided with explosives and the means for setting off the explosions. The only exception are those ships, which by the nature of their cargo (first-class fuel and other fire hazard loads) must not have explosives on board.

Each sailor, especially if he has to complete the navigation in the ice conditions, must be familiar with the explosive operations to such an extent that in case of necessity he could safely produce blasts for the progress

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of the ship in the ice tracts or for protection of it from compression.

Let us stop briefly on the substance of the blasting process and on the basic problems connected with the blasting operations, while sailing in the ice conditions.

The explosion is a rapid release of energy, connected with the sudden change of the condition of the matter. It usually is attended with the demolition of the surrounding medium, by the formation and diffusion of a special kind of disturbance - the shot or explosive wave, by the transition of the initial energy into the energy of the movement of the matter. The process of the blast may take place in various forms chiefly distinguished by the speed of diffusion: detonation, the usual explosion and deflagration.

The burning speed for various explosives fluctuates from one fraction of the millimeters to ten meters per second and to greater degree it depends upon the external conditions, chiefly upon pressure. At detonation - the instantaneous dissolution of the explosive - the blast wave spreads out with the speed of 2,000 to 85,000 m/sec. The detonation is related to the explosion of the first kind. The explosion of the second kind stands usually for the explosion with the diffusion speed of the explosive wave of 400 to 2,000 m/sec. Such an explosion exerts a lesser demolition effect upon the surrounding medium than the detonation.

A very slow dissolution of the explosives, called deflagration, usually takes place because of their poor quality (getting damp, getting too old, the insufficient force of the cap detonator) or in such a case when the pressure gases at the explosion does not reach the force inherent to the matter at the normal speed of its dissolution.

For the blasting of the ice the explosives of the mechanical mixture are used, namely the ammonites, containing chiefly the nitrate of ammonia with the addition of

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some organic nitro products (trotile, xylol, denitronaphtalin and others). The present-day Soviet ammonite consists of 88% of the nitrate of ammonia and 12% of trotile. The manufacture of the ammonite is exceptionally simple: the nitrate of ammonia and trotil are crushed, sifted, dried, ground fine in the ball mills and are mixing them in the proper proportions.

The ammonite is a relatively cheap explosive mixture. It is safest for transportation, in operation of same, safe-keeping and has a sufficient chemical stability. To the basic deficiencies of ammonite belong its hydroscopical inclination and also its pressing, which reduce considerably the explosive properties of ammonite. The ammonite which was stored for a long time formed solid clots.

The compactness of ammonite, as well as that of the other explosives, is expressed by relation of its weight in grams to its volume in cm^3. The best compactness for ammonite is the one ranging from 0.90 to 1.05 (not less than 0.90 and not over 1.05 grams in one cm^3). At another compactness of ammonite the blast will not take place or it will degenerate into deflagration, that is, in a very slow and ineffective explosion.

In order to produce the blast the explosive must be warmed through the contact with some object in white glow, by affecting it with friction, or giving it a blow or jolt from the blast wave of the cap detonator, or by producing a shock wave at some distance (a blast through influence). For the blasting of a charge of explosives the so-called initiating explosive (booster) is used, which is distinguished by its high sensitivity to the friction, blows, jolts and warming and is inserted in the cap detonators and electro-detonators.

Especially effective in detonation from the fire are the primary initiating explosives to which belong the fulminate mixture and the nitrous lead. A much weaker detonating effect comes from the secondary initiating substances, such as tetril, pentride and hexogen, but for

this matter these substances do explode well under the effect of the blast of the primary substances.

Section 44. Blasting of Ice.

The ice is blasted by fire or electrical method and also with the aid of the detonating string. (Fuze).

By the fire method the explosion of the cap detonator and the whole charge takes place under the effect of the burning Bickford string.

Bickford string (fuze) is the name for the fire conduction string used for inflammation of the cap detonator and other explosives. It consists of the core in the form of black gunpowder not pressed tight, and several attachments covered inside and outside by an insulating compound. The fire method does not require auxiliary instruments and is used for single blasts or for blasts of a small group of charges disposed at a small distance from each other. Among the deficiencies of the fire method are the hazard to which the blasting mechanic is exposed when attaching the Bickford string to the cap detonator, since in a defective string the burning is not even and the explosion can come either too soon or too late. Besides this the fire method excludes the possibility of several simultaneous blasts.

Figure 68. The cap detonator:
I. - copper; II. - cotton.

1 - cartridge, 2 - cup, 3 - fulminate of mercury, 4 - tetril, 5 - cumulative openings.

The cap detonator (Figure 68 /above/) which is charged with an initiating explosive consists of a metallic or cotton cartridge with a diameter of 1 to 7.6 mm and 47 to 50 mm long. In the cartridge made of copper, aluminum or iron, one end is covered with a bottom, into which a charge of the initiating substance is pressed in. In a paper cartridge (or perhaps cotton cartridge) both ends are open, but when the initiating substance is pressed in, on its outer end a recess is made in the same way as in the case of the metallic cartridge. As the initiating substance of the detonator explodes, the conflict of separate streams of gases takes place in this recession, the result of which the pressure of the gases is increased powerfully and they rush with force from the cartridge to the basic explosive charge.

Inside the cartridge of the detonator the initiating substance is enclosed with a metallic cup with the opening in its central part. Through this opening the flame of the burning bickford string gets to the charge of the initiating primary substance, or, as an alternative, the spark from the electric igniter. The detonation from the primary initiating (boosting) substance is passed on to the secondary initiating substance, and from the latter to the basic charge.

The cap detonators used in the USSR, depending upon the kind of the boosting substance with which they are charged, are the fulminate of mercury tetrile or nitrate tetrile substances. The nitrotetrile cap detonators are manufactured in the aluminum, iron or paper cartridges. The copper cartridges are not used for the nitrotetrile cap detonators since the combination of the copper and nitrous lead forms a substance marked by an exceptionally easy explosiveness. For the fulminate of the mercury tetrile used in thecap detonators both the copper and the paper cartridges are used, since the fulminate mixture destroys the aluminum.

For the ice blasting in the majority of cases the gutta-percha bickford fuze (the brown one) is used, further the double asphalt-type (the black one) for underwater

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blasting and the asphaltized type (the black one) for damp places. There is still another white bickford fuze, but it is used only in dry conditions and as a rule they do not use it for the blasting of ice.

The bickford fuze is set on fire, when connected with the cap detonators, by small burning sections of the same fuze on which at each 5 - 7 cm distance notices are made. Sometimes the bickford fuze is set on fire by hemp wicks or by special candles. The burning speed of the bickford fuze is about 1 cm per second and depends upon the properties and dampness of the fuze.

When resorting to the electrical method of exploding the charges a thin wire is made incandescent by the electrical current, while this wire is connected with the cap detonator and the source of the elecgrical feed. From the incandescent wire the igniting compound is set into flame, the cap detonator explodes and then the sharp cartridge, together with the basic charge of the explosive, go off.

With the electrical method one may produce a simultaneous blast of several charges disposed at considerable distance from each other. The blast mechanic can at the same time be at a considerable distance from the place of explosion (in the majority of cases on board the ship), that is, in safety. The defects of the electrical method of blasting are, in the first place, a complicated method of preparing the blast. One must lay out before doing anything the wiring, put them together and insulate them, check on the electro-detonators and the electrial grid. The electrical method of blasting demands from the blasting mechanic a considerably higher qualification than the one operating with fire method.

The insertion of the electro-detonators into the electrical circuit can be successive, parallel and mixed. At the successive connection the electro-detonators are inserted one after another in such a way that the whole current passes to each of them from the grid. In doing so the electro-detonators must have the same resistance. At

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a parallel connection one of the wires of each electro-detonators is connected with the main wire with the positive sign (+) and the other with the negative electrical sign (-). With such a method of connection the force of the current entering into each of the subsequent electro-detonators, gradually diminishes which requires the need of a greater force of the current, and consequently, also more power in its source. The mixed method consists of the connection of the electro-detonators with the feed source in groups, each of which is connected parallelly, while the separate electro-detonators, belonging to the group, are connected with each other subsequently.

Figure 69. Electro-detonators:
I. - of instantaneous action; II - of delayed action.

1 - the igniting wires; 2 - putty (?); 3 - incandescent bridge; 4 - the igniting compound; 5 - the little column of the burning substance; 6 - the fulminate mixture; 7 - tetrile.

The electro-detonator (Figure 69 /above/) is an ordinary cap detonator, to which the electric igniter with a resistance of 0.69 to 2.0 ohms is attached. The ends of the igniting wires are connected among themselves with a thin constantan wire, the incandescent bridge. The incandescent bridge is enclosed in a hard igniting shell in the form of a match-head. The electric igniter is fixed in the cap detonator with the aid of putty. Under the effect of the current introduced in the circuit the constantan wire of the bridge gets incandescent, igniting at the same time its surrounding shell, then the boosting substance of the detonator catches fire, from the detonation of which the whole charge explodes.

For blasts in the water the igniting and main wires are provided with rubber insulations; in a dry place the

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usual house bell wire can be used.

Depending upon the quality of the boosting substance contained in the cap, there are, as we already mentioned, electro-detonators of the mercury tetrile fulminate type, as well as azidotetrile type, and by the principle of their action - of the instantaneous or delaying action. The delaying action can vary between 2, 4, 6 or 8 seconds which is indicated on a special button attached to the igniting wires.

For explosion by the electrical methods, especial blasting machines of the type PM-1 are used, with the aid of which one can explode up to 100 electro-detonators, or of the PM-2 type, with which one can explode up to 25 electro detonators (Figure 70). In order to operate the machine, the handle of the key is rapidly turned. When using the blasting electro machines only the successive connection of the electro-detonators is used.

Figure 70. The blasting machines:

1 - of the PM-1 type; 2 - of the PM-2 type.

Frequently for the blasting of ice they use also the current from the power grid of the vessel; this makes it possible to use the method of the parallel connection of the detonators, while the detonators themselves may have varying types of resistance.

The simultaneous explosion of several charges can be effected not only with the aid of electricity, but also with the aid of the detonating fuze. The detonating fuze (cord) by its appearance differs from the bickford fuze only by the color of its braidings /it has a red braiding/. It burns slowly, but explodes well, since its core is made of a mixture of the mercury fulminate with tetrile and gelatins. The handling of the detonating cord is safe;

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at contact with fire it will start burning but its flame goes out in 10 to 15 seconds; it can be cut with a sharp knife but from a blow this cord may detonate, that is, explode. One has to keep the detonating cord in a dry place, since it will lose its detonating properties from dampness.

Before the explosion at the end of the detonating cord two knots are made (Figure 71), then it is stuck in the basic charge of the explosive, that is to the sharp cartridge without the cap detonator or to the igniting tube.

Figure 71. The paper cartridge with the detonating cord.

For the explosion of the detonating cord they connect its opposite end with the detonator, the capsule of which is exploded with the aid of a Bickford fuze. If the electro-detonator is used, for its explosion the current is connected. The cap detonator or the igniting tube is connected with the detonating cord and is tied with the knap (Figure 72). In doing so there is no need of a tight contact between the cord and cap, since the detonating cord is exploded not from the fire but from the detonation of the explosion of the cap detonator. The pieces of the detonating cord are joined in a flat knot, while the cores of the cord do not have to have a contact. The detonation is well passed on through insulation, the assignment of which - is to protect the core from humidity. At the explosion of the charges under the ice it is necessary to have the detonating cord well insulated at the place of its insertion into the sharp cartridge and also in the notches. The ends of the cord are greased with soot, with burning wax (ozocerite) or other material insulating the water.

Figure 72. The connection of the igniting tube with the detonating cord:

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1 - electrode from the vessel grid; 2 - the cap detonator; 3 - the detonating cord.

For safe storage of the explosive substances on board the ship an especial room is assigned with steam heat, good ventilation and a special exit to the deck. The size of this premise depends upon the necessary supplies of the explosives, that is, upon the size of the vessel and the nature of navigation.

For small ships with a limited range of Arctic navigation there is need for 0.5 to 2 tons ammonite, for large vessels engaging in long range sailing in heavy ice conditions, up to 10 tons. The explosives are loaded on board the ship in boxes. The boxes are g tightly packed to each other, between them felt is placed and are so fixed that during the rolling or shake-up of the ship, at impacts against the ice they could not move from their spot, collide with each other, hit against the bulkheads or against the pillars.

The cap detonators, electric detonators and the detonating cord are kept on board the vessel in special premise insulated from the storage place of the explosives.

The premises in which they are manufacturing the ignition tubes and sharp cartridges, are also insulated from the store rooms containing the explosives and boosters, in which case not more than 100 caps could be simultaneously taken care of.

When transporting ammonite the carriers must follow each other at a distance of not less than five meters and moreover, not more than 10 kg of the substance should be carried.

The cap detonators and the electro-detonators are carried by the detonating experts who must proceed at a distance from the sailors carrying the explosive substances. It is prohibited to take the explosives in the pockets or

to carry them under the top coat.

The transportation of the explosives is permitted only in special tarpaulin bags with wooden clasps and hemp cords. The charges of ammonite are carried in the bags with four compartments, with 2.5 kg of weight for each charge. For transportation of the cap-detonators, electro-detonators and other means of blasting also special bags are used.

Section 45. Preparation for the Blasting Operations.

The preparation for the blasting of the ice mounds include the operations connected with the manufacturing of the ignition tube, charges and sharp cartridges. Besides this one has to determine the weight of the charge, depending upon the conditions of the blast, establish the minimum safe distances from the ship to place of explosion of the charges and to dig ice holes for the charges.

The length of the Bickford fuze depends upon the depth of submersion of the ignition tube (Figure 73). However the fuze must not be shorter than 1 - 1.5 m, so that in case of several charges the first one should not explode sooner than in 1 to 1.5 minutes after the Bickford fuze of the last charge had been energized.

Figure 73. The ignition tube:

1 - the cap detonator; 2 - Bickford fuze.

Since the ends of a Bickford fuze absorb most humidity or are discolored, they are set off with a sharp

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knife on a plank. That end which is connected with the detonator, is cut roughly by 5 cm with a straight cut; the other the ignited end of the Bickford cord, on the contrary, is cut under an acute angle since the sharp cut can be more easily set on fire than the straight one. If the end of the Bickford fuze which is connected with the cap, is cut, with a dull knofe or under the angle of the braiding, frequently the opening in the cup is closed, the flame of the burning core of the cord does not reach the boosters, and the cap detonator does not explode.

The cap detonator before the insertion of the Bickford fuze is thoroughly inspected and cleaned. The Bickford cord is inserted in the cap detonator vertically until it tightly fits in; in so doing one should by no means turn the cord, since the cap detonator explodes from friction. Then the Bickford fuze is secured by pressing the cartridge with special tongs (Figure 74). These tongs are used also for compressing the cartridge of the cap and for the cutting of the cord. In the opening of one of the tongs' handles a knife is placed and on the other end of the handle a copper tip is fixed. One should compress the cartridge very carefully so that the cap should not be injured since that injury may cause explosion.

Figure 74. The compressing tongs:

1 - device for the compressing of the cartridge of the cap detonator; 2 - adjustment for the cutting of the cord; 3 - the knife; 4 - the copper tip.

When using the paper sharp cartridge (Figure 75) the end of the Bickford cord is wound about with the insulating or paper ribbon so that to have the cartridge setting real tight. After this the junction place of the Bickford fuze with the cartridge is carefully wound with the insulating ribbon, and from the top it is greased with ozocerite or some other water repellent compound, then the

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humidity will not get into the ignition fuze.

Simultaneously with the preparation of the ignition tubes measurements are taken of the thickness of the ice, and then the magnitude of the charge is figured. The thicker the ice and the greater the surface which must be demolished, that much longer must be the distance between the charge and the lower surface of the ice. The weight of the charge of ammonite is figured by the formula

$$K = 0.365h^2,$$

where h - stands for the distance between the center of the charge to the upper surface of the ice along the vertical;

0.365 - is the factor characterizing the solidity of the ice and the explosive force of the ammonite.

The weights of charges figured by this formula will give in kilograms for the magnitude h from 0.7 to 5.2 meters, as presented in Table 7.

TABLE 7.

Distance from center of the charge to upper surface of ice in m.	Weight of the charge in kg.	Distance from center of the charge to upper surface of ice - m.	Weight of the charge in kg.	Distance from center of the charge to upper surface of ice in m.	Weight of the charge in kg.
0.7	0.1	1.6	1.5	2.9	9
0.8	0.2	1.8	2.0	3.0	10
0.9	0.3	2.0	3.0	3.4	15
1.0	0.4	2.2	4.0	3.8	20
1.1	0.5	2.4	5.0	4.1	25
1.2	0.6	2.5	6.0	4.4	31
1.3	0.8	2.7	7.0	4.8	40
1.4	1.0	2.8	8.0	5.2	51

It is of utmost importance to determine exactly the distance from the side of the ship to the place of the explosion. If the distance is too short, the blast may injure the ship or cause traumatic shock to the crew on board the ship, if the distance is too great - the blast will not be sufficiently effective. The best effect is obtained from the explosions if they are made at a distance of one to two ice mounds from the ship. The distance securing the safety of the ship during the blast, is presented in Table 8.

TABLE 8

Weight of the charge in kg.	Safe distance in meters.	Weight of the charge in kg.	Safe distance in meters.
0.1	1 - 1.5	3 - 5	20 - 25
0.5 - 0.9	8 - 10	8 - 10	30
1 - 2	15 - 18	23	40

In order to plant the charge under the ice sometimes it is necessary to break open a hole through the ice. It can be carved out with the aid of a crowbar, ice auger (Figure 76) or with a blast. The carving of the ice with a crowbar is a long and tedious work. One can make it easier with an ice auger. In a heavy and solid ice the small holes are enlarged by successive blasts of small charges. For this purpose they usually set the charges weighing 0.8 to 0.4 kg, which will break through a hole in the ice up to 2.5 meters thick by resort to two to three explosions.

Figure 76. The ice auger.

The ignition is connected with the explosive substance on the spot where the explosion should be done before the placing of the charge under the ice. For single explosions small charges are sunk under the ice in the sharp cartridge of the manufactured paraffin soaked paper shell, while it is covered before the operation once more with a layer of paraffin (they drop the cartridges in a liquid paraffin).

Small charges from 0.1 to 1.0 kg assigned for explosion under the ice should be placed in glass jars. The jar is packed with fine ammonite and inside it a well insulated Bickford fuze is introduced. Then the jar (or the bottle) is tied to a rock with the bottleneck facing the bottom and drop it in the ice hole to appear under the ice.

The ammonite charges weighing 3, 5, 10, 20, 30 and 50 kg are placed in the cartridge (shell) made of sheet iron. The height of the cartridge is roughly one and one-half times its diameter. In the cover of the cartridge in order to introduce ignition pipes and electro-detonators, it is advisable to mount a cone-shaped hollow tube about 50 mm long covered with rubber or a cork as a socket (bell). The ends of the Bickford fuze or wire are let through the hole bored through the stopper. The stopper and basin of the cover is greased with ozocerite, with fat, or with some other isolating compound.

When everything is ready for the explosion, from the commanding bridge of the vessel they select the place for the planting of the charges and determine the surface of the ice which must be blasted. Then they lower on the ice surface by the storm trap the blasting crew consisting of one explosive technician and two sailors with the necessary instruments, the crowbar or ice auger, with a shovel, with the boat hooks, a pole and suspension load for the charge. Besides this the cartridges filled with ammonite are deposited on the ice. ~~Besides this they deliver on the ice the cartridges filled with ammonite~~.

In the majority of cases the charge is placed under the ice in such a way that between it and the lower surface

of the ice there should be a layer of water. It serves as a sort of cushion due to which the ice will not be crushed into small pieces, but is broken up in large slabs. As a rule, with such a method of planting the charge, the debris are almost non-existent and do not scatter through the air. In addition to this in the case of blast near the side of the ship the explosive wave sent through the water layers, will cause less damage to the hull of the ship, than the blow communicated through the ice, when the explosion is effected directly in the thick substance of the latter.

By tying the load and the rod to the cartridge, the explosives technician places in the so prepared charge the ignition tubes and is greasing the ends of the Bickford fuze with fat or ~~xxxx~~ ozocerite. For a better reliability one should place in each chafge two or three ignition tubes. While the explosives technician is equipping his charge, the sailors are busy digging the hole. Then the blasts technician checks the ready-made hole. He checks the hole with a rod to see whether under the upper cover there are no ice masses which would interfere with the lowering of the charge to the needed depth.

After investigating the hole, the explosives technician tells the sailors in which direction they must retire for protection. When selecting this direction the explosives technician must consider the direction of the wind, and also the lighting conditions in order to prevent the sun from blinding the crew which keeps in hiding for observation of the explosion. The sailors when retiring in the shelter take along all the instruments and supplies; only the boat hook and the bag with the ignition tubes remain within the hand-grasp of the explosives expert.

Section 46. The Safety Technique at the Ice Blasting.

The explosives technician informs the ship crew, by

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resort to signals of the impending explosions and passes on this information also to other persons who are standing near the blast spot, requiring them to promptly seek shelter. In daytime the sound signalization is effected by whistling or flags. At night time the explosives technician besides signaling with the whistle, must also signal with a lantern.

If the blasts are made near the ship, while on the upper deck or nearby on the ice surface simultaneously other operations are being carried out, the watch assistant of the captain follows the signals of the explosives technician and repeats them with a sharp whistle or bell.

The explosives expert is not authorized to carry out the impending operation until the signal from the ship is not repeated.

After the sailors retire to the necessary safe distance, the explosives technician issues his first "warning" signal and starts to plant the charges under the ice. The second "warning" signal is given by the explosives technician as he gets ready to ignite the Bickford cord and connects the chief wires to the terminal of the blasting machine or to the plug of the ship's power grid. When he hears the repeated signal from the ship, but not before a whole second after the second preliminary signal, the explosives technician issues a third "combat" signal. Upon doing so he ignites the Bickford cord or releases the current and drops the charge under the ice. When he drops the charger under the ice the explosives technician himself retires immediately to a safe distance.

The fourth signal, "all done" is issued by the explosives technician after the termination of the blast. If not all the charges have been exploded, the technician must sink those which failed to explode and after this he has the right to issue the fourth signal. One must not immediately come close to the place where the charge did not explode (one has to wait a certain conventional time, depending upon the length of the Bickford cord and the size of the charge). After the "all done" signal the crew leaves its shelter.

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As during the separation of the charges so also at the explosion one must keep all measures of precaution. An accident can happen during the preparatory operations through careless handling of the explosive materials. That can happen in particular by the careless cleaning from the dirt of the hollow part of the cap detonator.

One should not compress the cap detonator too closely to the cup. One should carefully, without great effort, stick the Bickford fuze in the cap, and the ignition tube - in the cartridge or right in the charge.

At the time of the explosion members of the crew may be wounded with debris of the ice. Accidents are possible to pass if the explosives technician will come too soon to the place of the explosion, remains on the explosion spot after the bust-up of the controlling ignition tube or, while preparing the ignition tubes, will use too short a Bickford cord, as a result of which in a blast series effected by the fire system, the first charge will explode before the explosives technician manages to ignite all the ends of the Bickford cords.

In the case of the electrical ignition accidents are possible if the blast expert, retiring from the explosion machine, leaves in it the keys (handle), when testing the electro-detonators with an excessively powerful current or when he pulls out from the electro-detonator the wires that have been built in it.

For the safety of the blasting operations one must observe strictly the following rules:

handle cautiously the cap detonators while cleaning them or when preparing the ignition tubes;

keep strictly to the established length of the Bickford cord when making up the ignition tube;

during the explosion check the time by a pocket watch and count the exploding charges, and leave the shelter only after they are all exploded;

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do not make more than 16 charges for a simultaneous explosion;

attach to the blast the weight solidly and reliably, keeping in mind that if the charge explodes on the surface, the ice debris will fly a long distance in all directions, which may cause accidents;

do not resort to the fire method of explosion if, by the conditions in effect, the explosives technician can find shelter only on board the ship, or cannot reach the shelter in proper time;

do not permit strangers on the premises where the ignition tubes are made, further where the sharp shooting cartridges and other charges are prepared;

one should not turn over to persons who do not carry out these operations directly, even the provisional safe-keeping of all manner of the explosive substances.

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Section 47. Blasting Operations in the Ice.

In order to protect the hull of the vessel during the ice compression, one can resort to two methods. Either increase the thickness of the ice artificially as it surrounds the ship, so that this ice barrier itself protects it from compression, or crush the ice and build up around the ship an ice cushion. During the time of compression the crushed ice exerts an even pressure on the sides of the ship, while a part of the pressure force of the ice is suppressed by the process of its thickening.

As a rule, in the navigation practice in the ice conditions, the second method of protection of the ship's

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hull from compression is used. By building up around the ship an ice cushion, the ice is being crushed the more forcefully, the closer it comes to the side of the ship. The close distance charges are planted right in the thick portion of the ice, roughly at a distance of three-fourths of its surface. It is quite advisable to fill the ice hole with water and freeze it in, right after the planting of the charge.

The charges planted at a certain distance from the ship should, to better advantage, be placed under the ice, since there is no need to crush here the ice too fine and, besides this, exploding under the ice the charge demolishes a considerably larger surface of the ice cover than when it explodes on the top of the ice. In such cases charges weighing 8 to 10 kg and more, are used and are disposed in a chess-board order at a distance of ten to twelve meters from each other.

In the Arctic navigation practice it happens frequently that a vessel is not in a position to successfully force the ice masses on a relatively small tract. To wait for the improvement of the ice situation is not always advisable since it may fail to improve, and moreover it can get even worse. In such cases as it had already been said, they resort to blasts. It is considered advisable to explode ice dams up to 500 meters wide and only in extreme cases those with a width of 1,000 meters. The exploding of wider dams or intensely hummocky fields of ice requires too great an expenditure of ammonite.

The best effect from the blast is achieved during the blowing of the wind favoring the course of the vessel. The most favorable are the head wind or the full force back stay wind, while the least advantageous is the half-wind. In the case of half-wind, even at a small force of the wind the ship undergoes intense friction against the compact ice and in the majority of cases it either cannot run forward, or will advance very slowly. In doing so the sail capacity oft he ship has a great and frequently decisive meaning, especially if it is in the ballast and has high vertical sides as, for instance, have the ships of the type of "LENINGRAD".

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If the shortest distance to the rarified ice or free water is in the direction of the course, but in regard to the course the half-wind prevails, it is advisable to change the course of the ship, bring the ship to the wind and in such a direction to force and blast the ice. The loss in the distance will be overly compensated with a more effective operation of the blast.

One should keep in mind that it is not permissible to carry out the explosion in the compact crushed ice along the course of the ship. The crushed ice cancels out considerably the impact of the bow part of the hull and provides frequently obstacles that cannot be overcome, delaying the progress of the ship. In addition to that, the friction of the hull with the crushed ice at its progress is a great deal worse than in the case of heavy ice slabs. One should not blast the ice opposite the middle and the widest part of the hull of the vessel, for in this place the ship is in the channel of the greatest width.

As experience has shown it is the most advantageous to carry out the explosion in the areas of the sector, roughly from 15 to 60° on both sides of the ship's course, that is if the ship intends to proceed at a 100° course, then the charges should be planted in the sectors of 40 - 85°, 105 - 150°, etc., (Figure 77).

Figure 77. Sectors of the most rational disposition of the charges.

In the crushed compact ice masses one must determine before the explosion the most favorable direction for the progress of the ship before the explosion. Having selected that direction one should determine which surface of the ice must be demolished. Then the demolition crew descends on the ice surface acting as indicated in Section 45. If at the time while the demolition crew prepares the blast, the ship continues to force its way through the ice, one should see that the ship should not come too close to the

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place of the crew's work. This is not only dangerous for the ship and the personnel on board, but also detracts the attention of the demolition crew.

Right after the explosion one must give full speed ahead and stop for the embarking of the blast crew only after the basic obstacle is overcome. At the corresponding work habit, only about ten minutes is needed for the explosion and the overcoming of the obstacle. For similar blast they use most frequently the charges weighing 10 to 40 kg, and in the case of a thick solid ice - also up to 50 kg. It is not advisable to use more powerful charges since the effect of same is not increased thereby. It is much better to increase the number of charges.

On the large ice banks the charges are disposed in rows in the "chess-board" order and the explosions are made with the electrical methods. The separate hummocky formations are blasted with several charges weighing up to 30 kg, which have been planted in the very thick body of the hummocks from various sides. In order to provide a channel for the passage of the ship in a continuous ice, it is sufficient to plant several charges weighing 1 to 2 kg at a distance of six to seven meters each from the other.

The explosions are started from the ice edge, gradually proceeding toward the ice massif, in which case the blasts should be completed with the electrical method and with the aid of the detonating cord. If it is necessary to lay a channel in the continuous ice, the blasts are used only at an opposite wind which will take out pieces of the blasted ice. During the action of the front wind or back stay the blasted debris of ice, on the contrary, get together and clog up the channel formed with the explosions.

In a continuous shore ice it is more advantageous not to break through the channel with explosives, but merely tear off the needed part of the shore ice. In doing so not only the force of explosion becomes active, but also the internal decomposition tensions emerging in the ice

under the effect of the wind. If the ship is stationed at the fast ice of the shore at the direction of the wind indicated on Figure 78, the charges are laid along the line B - V, passing through the place of the stopping of the ship and perpendicular to the direction of the wind. At the simultaneous blast of all the charges the ice will be knocked off and carried away from the shore. In this particular case the blast will be only the initial impulse for utilizing the internal tensions for explosions which have been built up in the ice under the effect of the wind.

Figure 78. Exploding the compact ice of the shore fast ice.

/Top - direction of the wind. /Right - the shore.
/Below - the sea. /Bottom - the vessel.

The blasting operations are used also in cases when the ship got wedged-in in heavy ice masses and the measures taken for its release, do not give positive results. The charges of ammonite weighing from 0.1 to 1.0 kg are laid under the ice to one and one-half times the depth of the thickness of the ice. As we know in such a disposition of the charge the pressure of the explosion is passed on to the hull of the ship only through the water, and the basic fofce of the explosion is directed upward for destruction of ice. In addition to this, the demolition fofce of the blast is, at the same time, spreading over a relatively large surface and the ice is broken up in large slabs.

Sometimes at the time of freeing of the ship from a wedged-in predicament, the charge is placed in the ice to the depth of three-fourths of its thickness. However, this should not be done. When the charge explodes in the thickness of the ice at a short distance from the ship, a considerable part of the blast energy is passed on through the ice to the hull of the ship. Together with compression experienced by the ship when wedged in, that may lead

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up to a serious injury to the hull. Besides this the ice grits of small debris of ice which originate in such a blast, increase considerably the friction of the hull of the vessel against the ice, not to say anything of the fact that the debris scattering to a considerable distance frm a true danger for personnel, both on board the ship and in the vicinity of the place of explosion.

When rescuing a ship from a wedged-in situation the explosions effected by the fire method along the bow section of one of the sides, are carried successively from the stern to the bow. As a result of this a tract of rarified ice forms along the side of the hull and the ship is freed from the wedge-in. In the relatively light ice the ice slabs broken off by the explosion, which do not get loose from the stern, are being pushed away with boat hooks.

In this case when it is necessary not only to free the ship from wedge-in but also to deploy it on a different course, the ice is being blasted on large surfaces, depending upon the deployment angle of the ship.

In the solid pack ice areas which are in the condition of the compression, no explosions are made, since they do not give positive results. It is more advisable to wait in such case for the change of the situation, that is, the change of winds or replacement of the current.

CHAPTER X

COMPUTATION OF THE SHIP'S TRIP WHILE SAILING IN THE ICE CONDITIONS

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Section 48. Laying the Course While Sailing in the Ice Areas.

When sailing in the ice-bound regions, by selecting the lightest ice or by using the tidal lead, the ship must frequently change its course, without taking into consideration the deviations from the general direction. If in such a process the sailing course is laid through the conditions of the drifting ice masses and there is no opportunity for determining the location of the vessel by astronomical or navigational means, one should use the method of adding up the mileage of the trip, as it had been worked out by the seagoing practice, and lay the courses not before, but after the ship already passed through these courses.

One of the most accurate methods of marking out the sailing course of the ship is as follows: the navigator prepares in proper time a grid in mercator's chart and marks on this grid each change of the course and speed on particular tracts of the trip (Figure 79).

Figure 79. Figuring out of the trip when navigating in the ice conditions on a diagram of the mercator projection.

/Above - Distance in miles.

/Vertical - Distance in miles.

As a result a series of sailing courses appears on the grid. By time intervals between the change of the course and speed on each particular tract the general course and the distance made, is computed, marking the results on the trip chart. When marking of time the course and speeds it is advisable to complete the log by the form presented in Table 9.

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TABLE 9

Watch from 16 to 20 hours * Compass course 62°					
Hours & minutes	Course in °	Speed in miles	Hours & minutes	Course in °	Speed in miles
16.00	70	3	18.10	70	3.5
16.20	67	4	16.40	56	4.2
16.42	60	5	19.05	60	4.6
17.30	52	4.5	19.48	62	4.0
17.45	64	3	20.00	67	3.7

If by the conditions of navigation the course is changed frequently, this is marked and recorded within certain intervals of time, for instance after 5 minutes by computing it thereafter with the average arithmetical method, the general course.

Naturally the compass course when drawing the chart, must be corrected preliminarily by the general correction of the compass. In doing so, if the difference in deviation between the extreme courses, followed by the ship in the course of one hour, was significant, then each of the compass courses must be first directed, with the general correction and then take their average true course which is marked down on the chart.

In this case when the conditions of navigation do not permit to determine the place of the vessel bo coastal landmarks or by astronomical observations, the computation in the ice setting must be made very carefully and not less frequently than in an hour the markings must be made from

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the chart, there to consider also the effect of the current and the drift of the vessel, together with the ice.

Section 49. Determination and Computation of the Drift in Arctic Navigation.

One of the very important and complicated elements of figuring out the trip on the ship when sailing in the ice conditions, is determination and computation of the direction and magnitude of the deviation with the drifting ice. The complication in figuring the drift of the vessel when sailing in the ice conditions, especially without any coastal landmarks, consists in the fact that directly from the vessel in the majority of cases one cannot observe the drift of the ice. The ship remains immobilized with reference to the ice setting, since it drifts along with them. In the presence of free water surfaces the ice, under the effect of strong wind, will change rather rapidly the direction of the drift.

Along with this the drift of the ice masses depends not only upon the local wind but also upon the winds passing through a number of adjacent areas. The extensive ice fields, when starting to move, acquire a considerable inertia which the local short-lived winds of small force frequently cannot overcome. Under the effect of the preceding wind in some places conditions for rarification of the ice masses can take place, while in the other parts the ice may be compressed. It will float or delay the drift of the ice masses under the effect of the new wind and will push them off their general direction.

Simultaneously the deviating force of the rotation of the earth, (the force of Coreolius) will also simultaneously effect the change in the direction of the drift of the ice masses with reference to the wind.

The higher is the ice disposed above the surface of the sea, with that greater force the wind will affect it, and thereby, sure enough, the speed of the drift will increase. A large iceberg with the varying height of its ends may have, not a straight line drift, but a rotating movement. Determination of the speed and the direction of the ice drift is still further complicated by the permanent current, and also by the phenomena of ebb and tide.

N. N. Zubov proposed to transpose the speed of the wind in meters per second, into the balls by the Beaufort scale, for the purpose of determination of the speed of the drift, by the following formula:

$$V = 2n - 1,$$

where n - stands for the balls of the wind;

$$1 \text{ m/sec} = 1.945 \text{ knots (roughly two knots)}.$$

The velocity of the wind drifts of the ice masses, in knots, are determined by the formula

$$c = 0.04\ (2n - 1).$$

One can also take advantage of the formula

$$c = 2n - 1 = V,$$

where c - stands for the velocity of the wind caused by the drift of the ice masses in miles per 24-hour day.

In Table 10 the relations between the force of the wind in balls and meters per second are presented, together with the velocities of the wind produced drift of the ice masses, these relations have been expressed in knots and in miles per 24-hour day. Furthermore, it can be objectively seen what in effect the wind and sea currents exert on the drift of the ice masses (with the exception of the currents caused by the same wind). Thus, for instance, if in a certain area there is a current, the speed of which is 0.5

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knot, then to stop the drift of the ice masses, together with the current, only wind of the force not less than that of seven balls can stop it. The wind blowing in the same direction can considerably expedite the drift of the ice masses. However, the ice drift depends not only upon the force and direction of the wind, but also upon the configuration of the coast, configuration of the bottom, the degree of the salinity of the water and distribution of temperature.

TABLE 10

Wind		Drift		Wind		Drift	
M/Sec	Balls	Knots	Miles /24-hr day	M/Sec	Balls	Knots	Miles per 24-hr day.
3	2	0.12	3	11	6	0.44	11
4	2	0.16	4	12	6	0.48	12
5	3	0.20	5	13	7	0.52	13
6	3	0.24	6	14	7	0.56	14
7	4	0.28	7	15	8	0.60	15
8	4	0.32	8	16	8	0.64	16
9	5	0.36	9	17	9	0.68	17
10	5	0.40	10	-	-	-	-

Thus, numerous factors are affecting both the direction and speed of the drift of the ice masses, and to figure it with an accuracy sufficient for practical purposes,

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is impossible. Therefore when sailing in the ice conditions, methods of determination of the direction and the velocity of the ice drift, are used as they have been worked out by prolonged experience in the history of the Arctic navigation of the Soviet sailors.

Let us consider one of the methods which is used precisely for this purpose. Let us assume that the ship appears in the point A (Figure 80), from which point the sound is dropped to the bottom of the sea to the point C, showing the depth N. Now let us mark down the time and let us give the slack M to the lead line; as the ship drifts to the point B, the lead line will again stretch out under a certain angle γ to the vertical. Thus we shall get a rectangular triangle ABC, in which we know the hypothenuse N + M and the cathetes N.

Figure 80. Determination of the direction and magnitude of the drift on board the vessels drifting with the ice masses.

It is not difficult to determine the value also of the second cathete AB, which represents the magnitude of the drift of the vessel during the time between the first position of the ship and the lead line to the second position. By computing the number of meters for as many as the ship drifts for a given number of seconds, we determine next the magnitude of the drift in knots. In doing so one should measure the depth not from the surface of the water, but from the place of the bend of the lead line on board the vessel.

We can determine the direction of the drift also by another means. For this purpose we have to make a disk from the plywood with an excision by the radius and divided into degrees with graduations of 10° from zero to 360°. This disk is placed on the lead line and its line is determined

0 - 180°, parallelly to the diametral plane of the ship. The graduation in the direction of the lead line plus the course of the vessel or minus 360°, if the sum is in excess of 360°, it will give the direction of the drift.

If the observation is effected from board the ship and the angle of the direction of the lead line and diametral plane of the ship is marked, the direction of the drift is determined by the formula:

For the starboard

$$A = K + 180° + B,$$

For the port

$$A = K + 180° - B,$$

where A - stands for the direction of the drift;

K - means the course of the ship;

B - stands for the angle between the diametral plane of the ship and the direction of the stretched lead line.

There is still another, fairly accurate method of determining the velocity of the drift. They drop a heavy weight of the manual or mechanical sound on the bottom of the sea, as has been done in the first case. At the moment when the weight touches the ground, they mark down the depth (figuring from the arm of the sailor holding the sound, or the place of bend of the cable of the mechanical lead line) and simultaneously designate the time by the stop-watch. After that a previously determined slack is given the lead line (10, 20, 30 meters, etc.); when the slack is fully stretched out, they again mark the time by the stop-watch. The determination of the velocity of the drift then boils down to the computation of the cathete of a rectangular triangle while we know one cathete (the depth), the hypothenuse (the depth and the slack of the lead line; and the angle of the incline of the lead line. At first they

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compute the angle of the inclination of the lead line, caused by the drift, by the formula

$$\sec\ \alpha = \frac{N + M}{N},$$

where N - stands for the depth of the sea;

M - signifying the length of the additionally stretched lead line.

Then they determine the velocity of the drift in miles per hour by the formula:

$$D = K\frac{\operatorname{tg}\ \alpha}{t},$$

where t - stands for the time while the lead line is slackened to the drift;

K - stands for the permanent factor of the transposition of the meters or the sea fathoms into the sea miles and seconds into hours.

In order to simplify the computation in determining the drift on the basis of the above stated formula, we can use Table II. When this table was set up a certain probable overbending of the lead line was taken into consideration. By this table on the basis of the depth and slackening of the lead line the magnitude of the drift is determined. For large depths the drift cannot be determined by the method just described.

For determination of the drift we can use also the dependence of the ice drift upon the velocity and direction of the wind, which is expressed by the formula

$$V = WK,$$

where V - stands for the velocity of the movement of the ice masses;

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W - stands for the velocity of the wind;

K - stands for the factors, for more or less compact ice masses equals 0.02.

TABLE 11

The Size of the Slackened Lead Line in Meters

Depth	Slack 10	Slack 20	Slack 30	Slack 40	Depth	Slack 10	Slack 20	Slack 30	Slack 40
10	34	55	75	95	35	55	82	106	129
11	35	56	77	97	36	56	83	107	130
12	36	58	78	98	37	56	84	109	131
13	37	59	80	100	38	57	85	110	132
14	38	60	81	101	39	58	86	111	134
15	39	61	82	103	40	58	87	112	135
16	40	63	84	104	41	59	88	112	136
17	41	64	85	106	42	60	89	114	137
18	42	65	87	107	43	60	89	115	138
19	43	66	88	109	44	61	90	116	139
20	43	67	89	110	45	61	91	117	140
21	44	68	90	111	46	62	92	118	141
22	45	70	92	113	47	63	93	119	142
23	46	71	93	114	48	63	94	119	143
24	47	72	94	115	49	64	94	120	144
25	48	73	95	117	50	64	95	121	145
26	49	74	96	118	52	66	97	123	147
27	49	75	98	119	54	67	98	125	148
28	50	76	99	120	56	68	100	127	149
29	51	77	100	122	58	69	101	129	151
30	51	78	101	123	60	70	103	130	153
31	52	79	102	124	62	71	104	131	155
32	53	80	103	125	64	72	106	133	157
33	54	81	104	127	66	73	107	137	159
34	55	82	106	129	68	74	109	136	161

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TABLE 11 Contd.

The Size of the Slackened Lead Line in Meters

Depth	Slack 10	Slack 20	Slack 30	Slack 40	Depth	Slack 10	Slack 20	Slack 30	Slack 40
70	75	110	138	163	155	109	156	192	225
72	76	111	139	165	160	111	158	195	228
74	77	112	141	167	165	112	160	198	231
76	78	113	143	168	170	114	162	201	232
78	79	114	144	170	175	115	164	204	233
80	80	116	146	172	180	116	166	206	241
82	81	117	147	174	185	118	169	209	244
84	81	118	148	175	190	119	171	211	247
86	82	119	149	177	195	121	172	214	250
88	83	121	151	179	200	122	174	217	253
90	84	122	152	180	210	124	178	221	258
92	85	123	154	182	220	127	182	226	264
94	85	124	155	184	230	130	180	231	268
96	86	126	157	185	240	133	190	235	278
98	87	127	158	187	250	136	193	238	277
100	88	128	159	188	260	138	196	242	282
105	90	131	163	192	270	140	199	246	287
110	92	134	166	196	280	142	202	250	292
115	94	136	170	200	290	145	207	255	297
120	96	139	173	204	300	147	210	259	302
125	98	142	176	207	320	152	216	266	310
130	100	144	179	211	340	156	222	272	317
135	102	147	182	214	360	159	227	279	325
140	104	149	185	217	380	164	233	287	333
145	105	151	188	219	400	168	238	294	342
150	107	153	190	222	420	172	243	301	350

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In the last determination one does not take into consideration the current which also may, more or less considerably, affect both the force and direction of the drift. It has been established that in the Northern Hemisphere under the effect of the Coreolius force, the ice deviates from the direction of the wind to the right by 2 - 4 rhumbs (26 - 47°). For more or less compact ice masses the angle of deviation is taken to be 40°.

Section 50. Determination of the Speed of the Ship Movement in the Arctic Navigation.

Let us analyze the simplest, the most widely used methods of determination of the speed of the ship movement when sailing in the ice-locked areas, since the ordinary methods of determination of the sailing speed of the ship, applicable in navigation in the free water, cannot be applied at all in the ice conditions.

The simplest and generally used method of measuring the sailing speed of the ship in the ice-bound areas consists of the following. From the bow of the ship they drop forward a splint, a piece of coal, slag, or some other object plainly noticeable on the ice surface. At the time when the dropped object is at the level of the stem, by its sign or whistle below they notify the commanding bridge of this. On the commanding bridge they fix the time on the stopwatch by the signal. When the dropped object passes through the beam of the stern, the observer assuming his place on the stern, signals that to the commanding bridge where at this moment the stopwatch is stopped. On small vessels the observer stands with his stopwatch on the stern and by the signal from the bow he starts and stops the stopwatch.

At slow speeds one man after dropping the object from the bow and starting the stopwatch, can pass to the

stern and there stop the stopwatch when the dropped object will appear at the stern.

On board the icebreaker "ERMAK" a still simpler method of measuring the sailing speed was used, which makes it possible for the navigator to measure independently the sailing speed of the ship without getting off the commanding bridge. The watch assistant of the captain, being on the bridge, drops from its wing on the ice at the side of the icebreaker a piece of coal or notices some special point on the ice surface. If there is water at the hull side, the watch assistant drops a splinter there. In doing so he marks on the stopwatch the time when he dropped the object. As soon as the dropped object or the one noticed on the ice surface reaches the current, ejected by the circulation pump, the navigator marks again the time by the stopwatch.

By the distance negotiated in the measured time interval, which is equal to the length of the ship, or to the distance from the wing of the commander's bridge to the current of the circulation pipe, they compute the hourly sailing speed of the ship.

Let us assume that the length of the ship between the stems is 99 meters. It had been established by the stopwatch that the object dropped from the wing of the bridge covered this distance in 66 seconds. Consequently, the speed of the ship or the distance which the ship negotiates within one hour or 3,600 seconds, equals

$$\frac{99 \times 3600}{66} = 5400 \text{ meters} = 2.9 \text{ miles an hour.}$$

Such a method of computing the sailing speed can be used on board any vessel, possessed of a bridge with abutting wings, convenient for watching the object passing at the pipe which squirts a stream of water from the circulation pump beyond the ship's side.

In order to expedite the computation it is advisable

to set up ahead of the time, for the vessel in question, a table by which, upon establishing the time stands on making the distance equaling the length of the hull, one can find immediately the corresponding speed.

When determining the sailing speed of the vessel also some other method of computation is used. The length of the ship (in meters) is multiplied by two and this contant magnitude is divided by the number of secunds, during which the dropped object made its distance on the ice, a distance equal to the length of the ship. For instance, the length of the ship is 99 meters; upon multiplying 99 by two, we shall obtain the permanent value of 198. If the observed object made 99 meters in 66 seconds, then the sailing speed of the ship per hour is 198 : 66 = 3 miles an hour.

It is necessary to determine the speed of the ship as often as possible, thus computing by the obtained value the average sailing speed in the ice conditions.

For the approximate computation of the distance made by the ship one should recommend the marking of all the changes of the course, marking down at the same time the time and speed of the course.

One can determine the sailing speed of the ship as it sails in the ice areas, by the principle of the simple log. We attach to the yarn of a certain length a weight and upon throwing it upon the ice, they simultaneously start the stopwatch. When the thread dropped overboard, will appear tightly stretched, the stopwatch is stopped. Let us assume that in 30 seconds of time 50 meters of yarn has been stretched out, the sailing speed will be

$$\frac{50 \times 3600}{30} = 6000 \text{ meters,}$$

$$\frac{6000}{1850} = 3.24 \text{ knots.}$$

This method of determining the course of the ship

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while it is sailing in the ice areas now-a-days is rarely used.

Recently the Soviet engineers recommended a drift sight - an instrument for the measuring of the speed of the ship when sailing in the ice conditions. This instrument had been at first established and then tested on an Arctic diesel electric ship of the latest construction.

The drift sight consists of a wooden frame in the form of equilateral triangle, at the engles of which sights are installed. The frame is fixed on the false side of the starboard of the wing of the commanding bridge in such a way that its plane would compose, with the diametral plane of the ship, an angle of about 40°, while the equal sides of the triangle would form two sight lines ABD' and ACD (Figure 81). By dropping the weight they measure the distance H from the axis of the frame fixation to the surface of the ice, depending upon the draft of the ship. The position of the plane of the drift sight frame, determined by the angle α, is periodically checked by the protractor.

Figure 81. Drift sight.

/Above, right - Axis of the frame fixation.

During the time of measurements the supervisor includes the stopwatch as soon as some noticeable point on the ice surface passes through the first sight line ABD', and stops the watch when this point passes through the second sight line ACD; while throughout this period of time the observer's eye is disposed in point A.

The sailing speed of the vessel is determined by the drift sight, as one sets out from the time when the observation point on the ice passes the distance between the sight lines ABD' and ACD, by the formula

$$v = \frac{s}{t},$$

where t - means the time in seconds as determined with the aid of the stopwatch;

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a - stands for the base in meters which is determined from the likes of the triangle ACB and ADD'.

From similarity of these triangles it follows that

$$\frac{AO}{CB} = \frac{AO'}{DD'}$$

or

$$\frac{AO}{CB} = \frac{AE + EO'}{a} .$$

Let us mark $AO = h$, $CB = c$, $AE = h_1$ and $EO = \frac{H}{\cos\alpha}$.

Then

$$a = \frac{1}{h}\left(\frac{H}{\cos\alpha} + h_1\right) = \frac{0.8}{0.55}\left(\frac{H}{\cos\alpha} + 0.25\right) .$$

Since

$$\frac{H}{\cos\alpha} \gg 0.25,$$

Let us write

$$a = \frac{0.8\,H}{0.55\cos\alpha} .$$

Thus

$$v = \frac{a}{t} = \frac{0.8\,H}{0.55t\cos\alpha} .$$

At the assigned value H and a, by resort to the above stated formula, one can set up the graph bf the sailing speed of the ship ahead of the time.

After they obtain the time t, the observer places it along the horizontal axis of the graph, and by the vertical axis he marks down the sailing speed of the vessel v in meters per second.

In slow movements of the ship instead of base a = 25 - 30 meters, the half of the base is used as formed by the sight line ABD' and the intermediate sight line - ACC'. When measuring the speeds they select such moments when the ship sails forward in a straight line without circulation.

After establishment of the drift sight on a diesel electric ship, comparative tests were carried out: simultaneously the sailing speed of the vessel was measured with the aid of a drift sight and by means described above. It so developed that on an average the difference in the results was all in all about 3 - 3.5%.

Taking into consideration the fact that the construction of a drift sight is a very simple one, and the results arrived at by its use are positive, which had been confirmed by the tests, one may assume that in a short time it will be used en mass on board ships engaging in Arctic navigation.

CHAPTER XI

PREVENTING AND ELIMINATING THE DAMAGE CAUSED TO THE SHIPS

Section 51. Ice Damage Caused to the Ships. General Indications.

Until recently the entirely false "theory" prevailed to the effect that when sailing in the ice conditions, the ice injuries are simply unavoidable. The life itself

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disproves this theory. We have many captains who being in charge of the ships, not even adjusted for sailing in the ice conditions, year in and year out, make trips in the ice locked areas of the Bay of Finland, in the Baltic, White Sea, Okhotski Sea and other frozen-in seas, without any ice damage.

The decisive conditions for safe, damage-free sailing in the ice areas is a good preparation of the ship itself and so also that of its crew.

On 4 June 194[illegible] the Minister of the Navy issued an order called No. 304, about the preparation of the ships and personnel for Arctic navigation. In accordance with this order, the chiefs of the steamship agencies are made liable to bring all the ships assigned for sailing in the ice conditions, into a condition in accordance with the regulations on the technical operations of the ships of the Maritime Fleet of the USSR, and to the requirements of the Sea Register of the USSR, and also to check on the operational qualities of the members of the ship crews, as well as to man the ships with fully qualified and experienced sailors. In addition to that, the chiefs of the steamship agencies must thoroughly indoctrinate the captains in regard to the tactics of navigation in ice and the guidance of the ships and also they must thoroughly check on the technical condition of the electro-navigational instruments and the magnetic compasses on board the ships, which are being sent to sail in the ice-locked regions.

The captains of the ships were required to study thoroughly the sailing directions of the corresponding ice conditions, further bearing on the operating of the ships in their courses and the ship conduction in the ice conditions. When he proceeds in a caravan or when he is singly conducted the captain must without fail make an independent computation of the trip in execution, without expecting to get the coordinates from the icebreaker. The captain must personally be convinced that the navigational and electro-navigational instruments are all in working order and they must strictly go by the corresponding regulations governing

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the work of the magnetic compasses in the area of Arctic navigation. He must insist that the navigators and the whole deck crew know thoroughly all the sound signals as used while sailing in the ice-bound areas; when he follows the icebreaker in the echelon or by way of single conduction, if it is impossible to observe the distance due to the excessively speedy sailing of the icebreaker, or due to the conditions of a heavy ice, he must use the signal "reduce the speed of your sailing course".

At the sharp turns of the icebreaker, at the obvious impossibility to proceed through the laid-out channel in trailing the icebreaker, it is prohibited to take any risk, but he must wait for the adjustment of the channel. As he follows the icebreaker in a caravan in a compact ice, the captain of the vessel must take cognizance of the nature and the degree of compactness by the bow of the vessel.

Before the trip is started and from time to time while making the trip, one must check on the water eliminating means, by checking their actual effectiveness; he must clearly be ready to take all manner of the ship alarms by paying especial attention to the skillfulness of the crew to handle the plaster, to drive in wedges, to put in their places the clamps and brackets, to fill the cracks and holes.

Before setting out to his sailing trip the captain must check on the presence of the damage fixing materials and the full supply of the lifeboats in accordance with the requirements of the Maritime Register of the USSR, and eliminate the induction errors of the magnetic compasses; he must correct all the magnetic compasses, and determine each watch regardless of the presence or absence of the gyrocompasses. On the trip the captain must quite carefully proceed to see whether he can avoid the breakage of the blades of the propeller and the damage to the rudder installation. As long as he is in the open sea on the anchor stations in case of the approaching of the drifting ice fields, the vessel must be taken promptly off the anchor, without permitting the onrush of the ice at the anchor chain.

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With the order of the Minister of the Maritime Fleet of the USSR an especial duty was placed upon the chiefs of the maritime inspection, with a view to effect the proper instruction and most meticulous inspection for the benefit of each vessel which is assigned to navigate in the ice conditions. During the time of this inspection they must check to see how well the ship guiding complement is familiar with the rules for the vessels conducted by the ice-breakers through the ice, and the deck complement knowing the sound signals, used during the conduction of the vessel through the ice.

In the struggle with ship damage in the Arctic navigation of decisive significance is the preliminary preparation of the vessel before it sets out on its trip. When they set to sea, each captain must provide his vessels with the necessary damage repairing and life-saving materials and installations. Among these damage-repairing materials we find: logs, cross-pieces, planks, nails and structural brackets, the bolts with nuts, shaped and sheet iron, wedges, cement, (sand for mixing with cement), calcinide soda (two-three handfuls of same are added to a pail of water when mixing cement, which makes it more rapidly viscous, especially at low temperatures) and also a supply of necessary instruments. In the capacity of the damage repairing and lifesaving equipment on board each vessel of the Arctic navigation one must have the chain-mail plaster (from four layers of tarpaulin with a metallic grid), a grease plaster (from double layers of tarpaulin and the collision mat) and the simple plaster (from a double layer tarpaulin).

Of great significance for the effective combatting of the damage and ice injuries are the study of same and a careful analysis. At a detailed inspection of the damage that had taken place as well as that of the ice injuries, their causes, conditions under which they had taken place, show up and it becomes clear what measures should be taken in order to prevent such cases.

The overwhelming number of cases of damage and injury to the ships while sailing in the ice conditions,

are typical, while most frequently the injury to the propeller blades are repeated, together with the cone and of the propeller shaft, the twisting of the rudder rod, the twisting of the rudder van, the injury of the stem and of the leaking of the forepeak, the ruffling and dents in the hull, the injury to the frame, plating of the hull, of the rudder machine or rudder mechanisms. It is quite obvious that if we become thoroughly acquainted as ship guides with the causes responsible for such damage, and also if we can give sensible advice of how to avoid them in one case or the other, the number of accidents can be reduced to their minimum.

Below we shall briefly stop to consider the basic, the most typical and the most frequently repeated ice injuries to the ships and on the matters of combatting this damage.

Section 52. Damage to the Propellers and Shafts.

The injury to the blades of the propeller in ice conditions can take place under any circumstances. The most probable are such damages in the case of the vessels sailing with the ballast or light weighing cubage loads when the propeller screw is laid bare or is carrying on at the surface of the water. Consequently, the risk of injury to the screws can be reduced to the minimum, in the first place, by increasing to the maximum the draft of the vessel with the stern by the corresponding loading and ballasting, and in the second place by not permitting powerful blows of the screw against the ice, for which purpose it is very important to properly appraise the solidity of the ice masses.

One can have a fair estimate of the solidity of the ice by its very appearance. Exceptionally solid are the debris of the transparent ice slabs, over 35 - 40 cm thick. Especially hazardous for the propeller screws are also the

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small monolithic debris of the ice from one meter thick, and heavier, which frequently appear as blocks with a snow surface. By careful observations made on the ice masses passing along the hull side and those approaching the stern of the vessel, it is necessary, in case the propeller is threatened with danger, to reduce its revolutions to the minimum, but not to fully stop them. The damage hazards of the slowly rotating screws is considerably less than those being stopped altogether.

The ships built for navigation in the ice conditions have, as a rule, the screws with removable blades. In case just one single blade (or several blades) is injured, the damage can be relatively easily repaired by replacing them with spare parts. The cast-iron or bronze screws are not suitable for Arctic navigation. In the case of cast iron screws the parts of the blades are cast off which disturbs the balance, causes vibration of the shaft and an intensified work of the deadwood. The blades of the brass screws twist easily from the first blows against the ice and they themselves can break or wedge in the screw. If only the ends of the brass blades are injured, so by providing a trip to the bow, on can correct the bent ends, or trim them off.

The replacement of the whole screw in the conditions of Arctic navigation is a very complicated task, however, as experience has demonstrated, fully feasible. In order to facilitate and expedite the replacement of the screw and its separate blades, whenever possible the load winches of another ship are used, which such ship and port cranes are available.

The propeller shaft as a rule must be more solid than the screw. However this condition sometimes is not complied with. In such a case when the screw strikes against the ice, the weakest part of the end shaft can break, namely the cones to which the screw is fixed. The ship which lost the end of the shaft with the screw, becomes helpless. In the practice of the Arctic navigation cases are on record that the divers were installing an end shaft and the screw in replacement of those damaged, with the aid of the ice-

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breaker's crane while the ship was stationed in the roadstead or at open sea, as the ice was drifting. This is the reason why each vessel which sets out to engage in Arctic navigation must, under all circumstances, have a spare end shaft, adjusted by means of its crankshaft to the deadwood and the spare screw.

Due to unskillful maneuvering in the ice it frequently happens that the rudder rod twists or the rudder's feather is damaged. On Figure 82 we see a characteristic case of the rudder rod twist on the steamship "YUSHAR" while engaged in navigation in the ice setting in the Bay of Finland. This came to pass because at the backing of the ship the rudder was not set straight.

Figure 82. A characteristic case of the twisting of the rudder rod when sailing in the ice surfaces of the Bay of Finland.

While sailing in the Bay of Finland in eight-ball strong ice masses consisting of the drifting fields and the ice debris up to 50 cm thick, the steamship "TOBOLSK" had a rudder rod twisted. The steamship "TOBOLSK" followed the icebreaker by cutting through an extensive drifting field, and in front of a heavy ice lead was compressed by the ice which telescoped against the left, leeward side of the ship. At the screw and rudder pieces of fine crushed ice were observed. Upon cracking, the ice field split perpendicularly to the sides of the ship at the stern post and moving slowly, the ice pressed against the rudder feather which at that time was in a straight position. As a result of this the rudder was pushed to the right roughly by 20°, since on the lee side of the screw and the rudder there was no ice (Figure 83), and consequently there was nothing to lean to. If the rudder had been set right to the side in good time, that would have considerably reduced the injury to the feather.

Figure 83. Twisting of the rudder rod by drifting ice.

In order to avoid the twisting of the rudder rod and injury to the rudder feather, the backing of the ship can be resorted to only in case there is a full assurance of the fact that there is no solid ice under the stern, which can injure the rudder feather or the rudder rod. During the sailing trip one cannot remove the twist of the rudder feather by the ship's means, as a rule. Even at the smallest twist of the rudder rod the angle of the shifting of the rudder is shortened for one of the sides. This causes great inconvenience and reduces the maneuvering qualities of the ship.

By working carefully in the ice-locked areas, by careful observation of the ice situation under the stern, by setting the feather of the rudder straight when the ship backs in a crushed fine grit ice, one can safely avoid the injuries to the rudder.

At powerful and sharp blows of the feather or rod of the rudder against the ice, and also in time of compression of the ice, one can be faced with the damage to the rudder plant or gear (basically the breakage of the transmission parts of the mechanisms). The frame of the helm gear may be injured or torn off its foundation. In general, the damage done to the steering engine becomes so complicated that it is impossible to repair it with the means of the ship itself. Therefore each vessel which sets out for Arctic navigation must have a manual steering gear, and also additional apparatus for steering the rudder with the aid of the stern capstan or the freight winches.

Let us mention here as an example the characteristic damage of a heavy duty icebreaker. Operating in the crushed large and fine-grits of ice of the Okhotskoe Sea, the heavy duty icebreaker got stuck in an ice bank before the tidal lead that was in front. With the intention to back out the icebreaker in order to force the ice bank, the second mate who was on his watch duty, gave to three engines a full--speed reverse run. The rudder was set straight. After it got off the ice bank for about the length of the hull, the icebreaker in its reverse run got into the ice with its stern, and then the second mate gave to all three engines

full-speed run ahead. The watch engineers, having carried out this order, heard in the stern engine section two powerful blows. A few minutes later a report was sent from the helm section to the commanding bridge that the steering engine had been damaged. By a subsequent external and divers' inspection it was established that the rudder post of the icebreaker in its upper portion is broken at a height of 1.6 meters from the helm port. The rudder brace was broken; the remaining portion of the rudder post in its upper section was bent toward the port by 150 mm from the diameter of the plane. The helm got off from the immobile section to starboard, and cut the limiter at the sector. From the contusion of the helm the pillar was broken, which dropped and broke the bench of the manual gear of the starboard rudder gear, tore off the bracket and damaged the bushing of the upper stuffing box of the rudder rod.

All these ravages which took place in a second and put the heavy duty icebreaker out of commission, came as the result of a blow of the rudder against the ice at full reverse run. The above described damage could have been easily avoided, if the second mate had clearly realized the possible force of the blow and if he had been watching the ice attentively, as it developed under the stern. Upon maneuvering in the sector of the rough crushed hummock ice, he would have been operating more carefully and only at low speed.

The force of the blow to the ship against the ice in tons can be determined by computing the speed of the run, tonnage, length of the blow and the angle of the attack of the ice (horizontal or vertical) by the formula

$$P = \frac{vD}{tg} \cos \alpha ,$$

where v - is the sailing speed of the ship in m/sec;

D - the displacement of the vessel in tons;

t - stands for the duration of the blow in seconds;

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g - stands for the acceleration of gravity (a permanent value equal 9.81 m/sec).

The force of the blow which the icebreaker sustained in the above described case, can be determined by this formula, setting out from the following magnitudes:

v - 4 miles per hour, or 2 meters per second;

D - 10,000 tons;

t - equals about one second;

α - 50°.

By substituting the indicated values in the formula, for the summation of the force of the blow, we shall obtain

$$F = \frac{2 \times 10\,000}{1 \times 9.81} \cos 50^\circ = 1280 \text{ m.}$$

Let us further compute the solidity of the rudder post on the permissible tension of the bend for the above given example. The section of the icebreaker's rudder post was

$$32 \times 30 = 960 \text{ cm}^2.$$

The maximum admissible tension of the twist for the cast steel at a changing load from zero to a certain magnitude P, as we know, is 1200 kg per 1 cm². Consequently, in our case the maximum admissible tension of the twist comes for the rudder post to:

$$1200 \times 960 = 1160 \text{ meters.}$$

Since the force of the blow exceeded this magnitude, and in addition, the rudder post was worn not less than 20%, the damage owing to the above described irregular maneuver, was inevitable.

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The computation of the force of the blow as presented above, and the comparative data about the solidity of the rudder post, quite naturally, are not sufficiently accurate, since we resorted to approximate values. However, for practical purposes such an accuracy is quite sufficient.

As we analyse the force of the blow, we can see that this force is directly proportionate to the speed, the mass of the icebreaker and its inverted proportion to the duration of the blow. The speed in its turn depends on the power of the engines and the distance of the icebreaker's run. At sufficient distance the force of the blow may reach such a magnitude that not only the shipping vessels cannot stand it, but also the powerful icebreakers. In the meantime the hull of the icebreaker has a special frame, due to which the blows are merely sliding off, the force of the blow is not immediately suppressed, as at head-on ramming blows, but is disintegrated into a series of components. However, on vessels with great frames the blows are usually of the head-on collision type and take place instantly, due to which the force reaches considerable magnitudes.

This is why at maneuvering in ice the ship captain must pay especial attention to the circumstances attending the reverse run of the ship, and depending upon the quantity and solidity of the ice disposed under the stern, not to have used the full speeds.

One should not permit in any case to deploy great speeds and slanting blows at which sudden powerful and sharp thrust of the stern are possible sideways, which will cause damage to the hull, screws, rudders and steering gear.

Each captain must figure the above orientational planning, he must know the force of the blow which he can produce with the full speed operation of the engine, as well as the admissible loads on the rudder rod, rudder feather, fore and after post.

Interesting is the case where the helm had been

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injured, together with the afterpiece of rudder and the rudder on a freight-carrying ship of the type of "LIBERTY". Following the heavy duty icebreaker in a rough crushed ice of three to four balls, this ship by-passed individual ice blocks by alternating runs. For a better turning ability at by-passing the icebergs a medium speed run forward was given and the rudder set to starboard side. In four minutes a full speed back run was given with the intention to have the ship deploy to the starboard after it suppressed its inertia. After 5 minutes, upon deployment of the vessel, the captain gave full speed ahead and seeing that the ship does not cancel its inertia, repeated the signal "full speed ahead". From the engine room they confirmed by telegraph "full speed ahead", however, the in~~f~~ertia in the ship movement backward was not suppressed, but was still more increasing. Once again after five minutes the captain set the telegraph on "stop" and by telephone passed to the engine room the order to give "full speed ahead". The watch duty engineer answered that the indicator of the telegraph showed "stop", and did not transmit the order about the full speed ahead. Two minutes following that a blow was felt caused by the blow of the stern of the ship against the iceberg. The helm was broken, the afterpiece of the rudder with the rudder rod were twisted 45 - 50°, the cheeks of the rudder got torn up dents, and one blade of the screw was fully broken off; besides that the rudder rod was twisted vertically.

After investigating the damage it had been established that the watch duty engineer, who had the rank of first-class engineer, answered by telegraph correctly to the command coming from the bridge, but gave to the machine section, instead of "full speed ahead", the "full speed backward". At his ~~dmxm~~ deposition the watch duty engineer declared that due to the frequent change of the runs of the engines, which were followed one after the other within the interval of a single minute, and even half a minute, he was excessively tired, due to which he mistook the direction of the run.

The chief engineer was not in the engine room, even

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though by the regulations governing the service on board the ships of the sea fleet, it is provided that at the execution of maneuvers, at the approach of the vessel to the port, or as the vessel leaves the port, and also when passing through narrow and dangerous places, the chief engineer must stay in the engine room and personally direct the operations of the engine. Thus, the cause of the heavy damage was not only the careless attitude to his work of the watch duty engineer, but also a direct violation of the Regulations governing the service on board the ships of the sea fleet, on the part of the chief engineer, who, well aware of the fact that the ship is passing through narrow and dangerous places within the fields of heavy ice, entrusted the steering of the engine to the young and not even licensed engineer.

The captains of the ships navigating in the ice-locked areas, must demand in all strictness that during the maneuvers in the engine room under all conditions the chief engineer, or in the worst case, the second engineer, be at their post.

Section 53. Damage Caused to the Hull of the Ship.

When forcing the ice both in the independent navigation of the vessel itself, as well as when it follows the icebreaker, the most frequent injuries are caused to the stem and the cheek formations, especially in the case of ships, the bow part of whose hull is not adjusted by their construction, to the sailing in the ice conditions.

Most frequently the damage to the stem is caused as a result of the blows against the ice under an acute angle. The damaging of the stem is possible also when hitting the ice under right angle, but this is rather rare and only in the case of a very heavy blow against a compact ice. Therefore when forcing the ice obstacles one should follow

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closely everything so that the blow against the ice be made by the stem at a right angle, and the force of the blow should be coordinated both with the solidity of the ship and that of the ice. At each injury to the stem the penetration of the water in the forepeak, is inevitable. This is explained by the fact that the stem is rigidly connected with the first sheets of the plating of the hull, and therefore when the stem is deformed the rivets are cut loose, and frequently even the seams adjacent to same are set apart.

Before setting out for a trip in the ice-bound areas, one should install in the forepeak of a weak vessel, provisional reinforcements made of logs and heavy planks. In order to eliminate the penetration of water in the damaged places of the forepeak, also wooden boxes are placed, however, filled with cement and reinforced with brackets. The cement boxes must be on board the vessels of Arctic navigation more solid than those on board the ships navigating in free water. At this operation it is advisable to place in the concrete a metallic armature which will considerably increase its rigidity.

The blows of the ship against the floating ice blocks are received in the majority of cases by the cheek parts of the hull, and most frequently we find injury in those places. The blows are taken by the ship not only when sailing independently, but even when following the icebreaker in a channel or even when being towed, since under these the hull of the icebreaker in a laid-out channel fairly large and solid ice blocks emerge to the surface. At powerful blows of these blocks against the hull the frames are twisted or broekn, dents are formed in the plating, rivets are being shorn off and the seams of plates get loose; it is also possible to sustain holes in the area of the waterline.

As soon as the water penetrates in the hull, one must immediately take measures so as to reduce the penetration of the water through the shorn-off rivets, loosened seams and actual holes. The weakened rivets are being

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hammered over and if necessary to be padded with lead or wound with wool painted over. The holes caused by the shearing of the rivets are filled with wooden or metal stoppers of the corresponding diameters or are screwed into these holes by threateded stop pins. If the water rushes in not far from the water line, then they produce list for its stopping.

In case the plating tears apart of the seams of the hull get loose, the incoming water is stopped with the aid of the "cushion". The cushion is made of heavy planks of the corresponding size and shape, to which tarpaulin is attached covered on top with a heavy paint (with red lead or the white lead paint), and then with felt. All this is covered again with tarpaulin which is fixed by the ends of the planks. The cushion is set against the hole also with a girder set up in the form of brackets, and with the aid of pipes they press it against the hole tightly.

The more difficult it is to avoid the ice injuries in the conditions of compression of the heavy ice masses, but also in such cases one can preserve the vessel from serious damage by measures that have been taken in proper time. At compression one must be especially alert to the protection of the rudder and the screw.

In case one of the compartments of the vessel is flooded, one must set up a careful observation of the bulkhead. All the unreliable watertight bulkheads must be reinforced with brackets made from logs or girders and planks. Large scale injuries caused to the watertight bulkheads because of the pressure of the water is almost impossible to eliminate while sailing. Small injuries to the bulkheads are eliminated in the same way as the holes and defects in the plating of the hull.

Section 54. Freezing out of the Ship.

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The simplest, most convenient and safest method of repairing the ice damage and other injuries of the underwater part of the ship, naturally, is docking the ship or placing it into a dock or building slip. However this is not always possible. Sometimes the seagoing ship cannot continue its trip without repair of the underwater part and must stay for wintering in the ice-locked area.

In such cases one can carry out the so-called freezing, that is, the laying bare of the underwater part of the ship which is in need of repair. The freezing is possible in such areas where the average temperature in the winter months is steady at - 10°, - 15° C.

As experience has shown one can carry out freezing not only on small but also on large tonnage ships, without taking them to the docks, for the purpose of such repairs as that of deadwoods, helm, kingston pump, the riveting or welding of the rivets and plating, the change of the plating sheets of the underwater part of the hull, and others.

For the purpose of freezing the ship is stationed, so far as possible, in an area devoid of rapid and powerful currents. They start this work when the ship has been brought into the condition of conservation and when the thickness of the ice reaches not less than 25 - 30 cm. Around the ship they lay out the contours of the future ditches. Their length by the side of the vessel is usually taken to be 1.5 - 1.8 meters, and the width - 1.0 to 1.2 meters. In the stern the ditches are disposed by the frame of the ship's hull, by the size of the screws, and the surface of the afterpiece of the helm, in which case however, it is not advisable to break the ditches on a surface of over 1.5 to 2.0 meters.

After digging out the ditches each three to four days the top layer of the ice is chipped off from their surface, 5 - 15 cm thick. In the place where the ice layer had been removed, in three to four days from the internal surface (on the side of the water) an ice mass freezes on, roughly the same or even thicker layer. The thickness of

the ice frozen from below depends upon the temperature of the water and the outside air. In such an order the chipping off of the ice is continued until those parts of the hull are laid bare which require the repair.

As the ditch is deepened one must carefully watch that the thickness of the ice at its bottom should not be less than 150 to 200 cm at the beginning and 250 to 300 cm at the end of the freezing, or otherwise the ditch can be flooded with water.

Between the surface ditches the cross-pieces of ice are left over 35 to 40 cm wide (Figure 84). These cross-pieces serve as the water-tight bulkheads in case of flooding in one of the ditches, and at the same time increase the rigidity of the bottom of the ditch, by taking on a part of the hydrostatic pressure affecting it.

Figure 84. The cross-pieces between separate ditches at the freezing of the ship.

In the stern part of the ship, behind the basic ditches special controlling ditches are disposed. For single-screw vessels they make three controlling ditches, and for the double-screw vessels the number of the controlling ditches is four. The controlling ditches, by increasing the surface of the heat release, contribute to the quickened freezing of the ice from the internal side of the basic ditches (disposed at the screw).

For double-screw ships, besides the controlling ditches, also auxiliary ditches are made for the convenience of removal of the propeller shaft.

As the ditches are deepened they make abutments (Figure 85) in accordance with the sharpened contour of the hull, in order to obtain a roughtly even surface of the ditch on the top and at the bottom. In addition to that the abutments reduce the tensions in the corners of the ditches, which is caused by the pressure of the water against the ice.

Figure 85. Abutment in the ditch while freezing-in the ship.

The repair of the underwater part of the hull is started five to six days following the termination of the freezing. During this time the ice on the bottom of the ditch has been thickened to the point that the work becomes safe. The cross-pieces between the ditches which do not interfere with the work are not removed.

The freezing of the ships by the method set forth above takes much time and in the majority of cases takes the coldest period of winter. Sometimes they use another one more complicated, but also a more effective method of freezing. From iron 3 to 4 mm thick they weld tanks 150 x 200 cm of the size of their bottom and a height depending upon the depth of the frozen dith. The walls of the tank are inclined 1 : 20, so that they could be conveniently removed. For convenience and the expediting of the operations, one may use dismountable tanks with hemp or rubber pieces in the junction places. When the ice in the freezing area reaches the thickness of from 25 to 30 cm, the tanks are placed on its surface at a distance from 0.7 to 0.8 meters from the side of the vessel, with the bottom turned down, and the upper part turned up. At a distance of 0.3 to 0.4 meter from the walls of the hull a lumber scaffolding and the walls of the tanks are packed with masses of fine crushed ice and snow, which in two to three days freezes in solidly.

Then the iron tank is removed from the ice for which purpose they heat the tank consisting of one piece, while the dismountable one is taken apart. The lumber scaffolding is also taken apart while the basic ice around the frozen-in ditch is chipped off. The ice ditch being afloat, is taken to the side of the ship and is filled with ballast. In such a position the ditch with the ballast is kept for three to four days. During this period it freezes together with the basic ice and the side of the ship. Further the

ballast is taken out, and the ice wall which had been frozen to the side, is chipped off and the ditch is fully completed.

In order to have the side wall of the artificial external ditch freeze more rapidly and more reliably, on the surface of the ice across the wall iron pipes (cartridges) are placed, with a diameter of 20 to 25 cm, and welded from one end. The length of the cartridges must correspond to the thickness of the ice wall of the ditch. On one square meter they use two to three cartridges; they are so installed as to have the welded ends turned to the lumber scaffolding, and the open ones should lean against the iron wall of the tank.

CHAPTER XII

RESCUING OF THE SHIP IN THE ICE CONDITIONS

Section 55. Particular Features Attending the Rescue of Ships in Ice Conditions.

In the ice conditions a situation arises far more frequently than in the free water, when a ship being in a dangerous or distressed condition, cannot overcome the emerging havoc with its own forces and means, and must ask for assistance of the icebreakers or other more powerful ships.

In the majority of cases the ships get into the distressed condition when the elementary rules and

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regulations are not observed even though they had been worked out in the practice of the Soviet sailors through a period of many years.

Great importance is attached to the proper equipment of the ship. Since the sailing conditions in the ice are varied and depend upon the time of the year, the area of navigation, on the peculiarities and the technical conditions of the ships, it is not possible to set up any general or obligatory standards of ship equipment. Each ship captain, each branch of service operating the steamship agency, must know well the local conditions of navigation, the peculiarities of the operation of ships and setting out from this information, determine the equipment needed by the ship for the impending ice trip. The insufficient supplies push the ship, as a rule, into a distressed condition, while the excessive ones, on the contrary, reduce its useful load volume, and consequently the efficiency of operations. Moreover, they build up the danger of the self-ignition of the coal, the spoiling of the food supplies, etc.

However, in spite of the accumulation of a huge experience in the matter of supplies, up to this time quite frequently the ships, due to insufficient supplies of fuel, lubrication, water and food, get in distress and plead for assistance of other ships. Up to this time there are cases when the chiefs of the steamship agencies, ports, ship captains, disregarding the elementary rules of construction, preparation and reinforcement of the ship setting out for a trip in ice conditions, send out the ships not adjusted to the navigation in the ice-covered areas. The neglect leads up to damage, huge loss of time and heavy losses.

Frequently the ship captains not only of small but even of large vessels, are liable for the damage. By disregarding the elementary rules of navigation in the ice conditions, they lead their own ships into narrow channels between the large ice fields, drifting in the sea, will not take timely measures to take their ships to safety, in places free of ice floes such as the estuaries of the rivers, ports, bays and straits. As a result they get into

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the ice drift, go through distress, and are exposed to damage.

When the icebreakers or other ships proffer aid to a ship in distress, the problems of the mutual liability and accounting arise between them. Some ships' captains stand up to this time by the improper point of view, and figure that the legal side of the question does not have any relation to the success in navigation and does not solve the problems of offering aid to the ship which got into a risky position while sailing in the ice-locked areas. However at a careful inspection of the damage which took place in the Arctic navigation, we shall come precisely to the opposite conclusion. Frequently not only the amount of loss, but also the success of the rescuing operation depends upon the fact how timely, proper and legally formulated are the legal relations between the rescued ship and its rescuer.

The Soviet sailors offer aid to the ships in the most complicated and dangerous conditions with self-denial and without expectation of profit. But this does not mean that they should be deprived of a merited compensation for the heavy and dangerous work connected with the rescue operations. The material stimulation has an important role in the organization and execution of the rescuing operations.

Touching upon the problem of the importance of compensation for the rescue work and by clarifying Section 174 of the Code of Commercial Sea Navigation, the Maritime Arbitrating Committee (MAK), in its decision in the case of the steamship "SAKHALIN" pointed out: "Participation in the rescu ng compensation by the intent of the legislator is the premium given for good work, inspiring the immediate participants for rescuing operations, and compensating them for their risk, daring and skill. To deprive in such conditions the crews of the rescuing ship of their compensation due to the fault of the crew of another vessel, would be manifestly improper and at variance with the direction indication of the law".

It is equally important to determine the amount of expenses borne by the rescuing ship when offering aid, not excluding those special cases when the rescued and rescuing ships belong to one and the same owner.

When taking the aid of another ship, one must clarify the mutual relation with the rescuing ship, to sign the rescuing agreement on a form of the Maritime Arbitration Commission (attachment 4) and give the case such a shape that excessive expenses dealing with the rescue operation be avoided.

In its own turn each vessel, and especially one navigating in the ice conditions, must be prepared to immediately and effectively offer aid to another vessel. In doing so one should not forget about the material stimulation. This practice must be given such a legal formulation that the crew of the rescuing ship should not be exposed to unnecessary difficulties in receiving the merited compensation, and to have the steamship company pay the expenses connected with the rescue operations.

A considerable number of very instructive cases connected with the rescuing of the ship in ice conditions has been analyzed in the Acts of the Maritime Arbitration Commission (MAK) during the relatively short period of its operation (from the 1st of January 1931). There is no doubt that each case of the ship rescuing in the ice conditions has its own particular features, and for this reason the statues applicable in one case, may turn out to be entirely unapplicable in another case. As a rule the decisions of the Maritime Arbitration Commission (MAK) in many fundamental problems serve as the basis for the subsequent actions in analogical cases.

Below we analyze the most typical problems arising in connection with the rescuing operations in the ice conditions (on the basis of the MAK practice). These problems are considered not only from the legal, judicial point of view, but also to a certain extent from the point of view of good maritime business practice.

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Section 56. Rescuing of Ships int the Ice Conditions in Connection with Exhaustion of the Fuel and Drinking Water.

1. The steamship "SNABZHENETS No. 1", which arrived with a load of lumber could not enter the port of its assignment because of the ice conditions. The ship did not have the proper supplies, and while it was waiting for the improvement of the ice situation it had fully expended its fresh water. As a result of this they had to discontinue the work of the steam boilers.

Under the effect of a wind blowing with a force of eight balls the steamship "SNABZHENETS No. 1" began to drift along the edge of the ice in the direction of the weather side island with rocky bars. The captain of the ship suffering distress, dropped anchor and at the same time turned to the ship "KOMSOMOLETS" seeking aid. The steamship "KOMSOMOLETS" approached in the floating ice masses of six to seven balls the steamship "SNABZHENETS No. 1", moored around its sides, delivered 25 tons of water and waited until the rescued ship could raise its steam and then the anchor. After raising the anchor the steamship "KOMSOMOLETS" towed the "SNABZHENETS No. 1" in the nearest bay safe from ice hazards. The owner of the steamship "KOMSOMOLETS" submitted to the navigation company which owned the steamship "SNABZHENETS No. 1" the bill for the payment of actual laid-out expense items and the rescuing compensation. The owner of the rescued ship, upon confirming his agreement to pay the actual expenses, refused to pay the rescue compensation, motivating his decision that in this particular case the regular towing, and not the rescuing operations took place. The issue was submitted for decision to the MAK.

The MAK, guided by Sections 164, 171 and 172 of the Code of Commercial Maritime Navigation, had fully satisfied

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the claim of the steamship "KOMSOMOLETS". At the trial of the case it had been established that the captain of the steamship "SHABZHENETS No. 1" signed with the captain of "KOMSOMOLETS" a rescue contract. The steamship "SHABZHENETS No. 1" was in need not so much of the ordinary towing, but, being in a distressed position required also other aid. The coal supply on board the ship was nearing its exhaustion, the fresh water was unavailable, the boilers and the engines were out of commission. The steamship "KOMSOMOLETS" not only supplied the damage suffering ship with fresh water, but, waiting for the raising of the steam, kept it from its drifting to the shore, since the anchor was a ~~xxx~~ poor help, fir it kept the ship stationed with great difficulty and even if it could do that, the anchor chain was unreliable. In these circumstances the steamship "KOMSOMOLETS" exposed itself to be drawn into the ice drift, undergo damage to the rudder, propellers and maybe itself be thrown out on the rocky reefs. These conditions were the foundation for the MAK to give full satisfaction to the claimant.

2. The steamship "LUNACHARSKIY" during delivery on the roadstead of mazuth to the steamship "ZYRYANIN" was pressed against the coast and grounded on the shoals, by the wind of eleven-ball force and by drifting ice. Around the ship a huge mass of ice accumulated, the wind did not calm down. The captain of the ship "LUNACHARSKIY" was forced to give the distress signal. In spite of the most adverse conditions he was immediately approached by the steamships "SUSANIN", KOMSOMOL'SK", "IGARKA", "ARKTIKA", "GERKULES", and others. The rescuing operations were headed by the captain of the ship "SUSANIN", who also signed a rescuing agreement with the captain of the ship "LUNACHARSKIY". By the moment when the rescuing operations started "LUNACHARSKIY" was grounded by its bottom on a shoal, was washed in by sand up to 1.5 meters, and besides that large masses of ice were grouped around it.

After the sounding of the depth, which had been carried out in extremely difficult ice conditions, several anchors were given in a goose line. After this the heavy winding tackles and towing cables were attached to the

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anchor chain and moorings encircling the damaged ship. From the steamship "LUNACHARSKIY" about 1,000 tons of mazut was pumped out and also the whole water content. The rescuing operations continued for fourteen days and only as a result of self-denial of the ship crews and a guidance marked by high qualifications, the steamship "LUNACHARSKIY" was safely taken off the shoals and brought into the nearest port.

The owner of the saved ship did not contend the actual expense bornes by the rescuing crew, however, denied the rescuing compensation to the claimant, motivating his decision with allegation that the vessels and floating means belongig to him had been participating in the rescuing process.

MAK, guided by Sections 164 - 173 of the Code of Commercial Sea Navigation, gave full satisfaction to the claimant and distributed the rescuing compensation among all the rescuing vessels, in accordance with their participation in the rescuing operations.

3. The Diesel propulsion ship "ADMIRAL SENYAVIN" was called out to bestow aid on the steamship "KOVDA" which, having exhausted all its fuel supply, lost its seaworthiness and was drifting in the large grit hummock ice of 8 - 9 balls, while visibility was poor. The ship "ADMIRAL SENYAVIN" guided by the coordinates and radio location passed on to it by the ship in distress, had fairly promptly discovered the steamship "KOVDA", took it in tow and delivered it to the closest safe port. Also between the captains of the ships a rescuing agreement was made. However, the owner of the steamship "KOVDA", alleging that in this case not the rescuing took place, but an ordinary towing process, refused to pay the rescuing compensation.

MAK, going by Section 164 of the Code of Commercial Sea Navigation, gave full satisfaction to the claimant. In this case the steamship "KOVDA", in a heavy ice situation (large broken hummock ice, 8 - 9 balls) was in a condition that was not seaworthy and on its own force could not reach

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a safe port. The ship and the cargo loaded on same were subjected to real danger. As a result of the actions of the Diesel ship "ADMIRAL SENYAVIN", which, sailing in a heavy ice situation, also had been subjected to real danger, the steamship "KOVDA" was brought in tow without any danger to the nearest port.

4. The steamship "CHAPAEV", with a limited supply of fuel in its possession, calculated only for a normal trip, was compressed by the ice masses in the sea; it could not get out to free water on its own, and thus arrive to the nearest safety port. The captain of the ship "CHAPAEV" pleaded for help with the captain of the steamship "VOYKOV". The steamship "VOYKOV", having a more powerful engine, a solid hull and sufficient supplies of fuel and water, made its way toward the steamship "CHAPAEV", chipped off the ice around it, took it in tow and brought it into a safe port.

The defendant denied to the claimant the payment of the rescuing compensation, alleging that the captain of the steamship "VOYKOV" refused to deliver the fuel to the steamship "CHAPAEV", which would have enabled the latter for independent sailing to the port of safety. However, the MAK found the material submitted at the trial establish that the delivery of the fuel from steamship "VOYKOV" to the steamship "CHAPAEV" in the conditions of seven-ball wind and movement of the ice masses was impossible. But even if the steamship "VOYKOV" had delivered the fuel to the steamship "CHAPAEV", and the actions of the first aiming at averting the danger threatening the latter, had been thereby ended, then even in this case, inasmuch as these actions under the given conditions had a useful result, the rescuers, in accordance with the Section 164 of the Code of Commercial Sea Navigation, would be entitled to rescuing compensation. On this basis, guided by the Sections 164 and 172 of the Code of Commercial Sea Navigation, the MAK gave satisfaction to the claimant.

Section 57. Rescuing of the Ships in the Ice Conditions in Connection with the Damage.

The steamship "POLINA OSIPENKO", having sailed in the broken-up ice masses of five to six balls, had successfully overcome the ice masses. However, its boiler went out of commission, even though its technical condition had been unsatisfactory even before the ship set out on its ice sailing trip. The engines had to be stopped and the ship began to drift with the ice masses in the direction of a sand cape around which considerable masses of ice were accumulating. The ship became entirely helpless. The captain of the ship "POLINA OSIPENKO" turned with the request for aid to the diesel ship "BODRYY", which happened to be in the area of the distressed vessel. The rescuing agreement was completed. As a result of the aid bestowed by the rescuer ship, the distressed vessel was taken out of the ice area and towed to the nearest safety port.

The defendant admitted justification of the demands of the claimant in regard to the expense items borne by himself, but refused to pay the rescue compensation, under the pretext that no danger was threatening the rescued vessel, nor the rescuing vessel, but the actions dealing with the giving of aid did not call for any special effort on the part of the rescuer.

MAK, whither the issue had been submitted, did not agree with the defendant basing its decision on the fact that his assertions are in contradiction to the Regulations of Chapter IX of the Code of Commercial Sea Navigation and the actual conditions of the case. The steamship "POLINA OSIPENKO" was threatened by the real danger of loss. The ship "VODNYY" not only carried out the towing of the injured steamer, but spent a long time in the drifting ice masses searching for it in poor visibility. On this foundation and guided by the Chapter IX of the Code of Commercial Sea Navigation, the MAK gave satisfaction to the claim of the ship "VODNYY" in the sum of 25,000 rubles.

In the meantime the timely repair of the steam boiler of the steamer "POLINA OSIPENKO" and bringing it in a good technical condition, should have taken a whole 24-hour day and required only 6,000 rubles of expenditure.

This case showed how through the preparation of a ship must be made for a trip in ice conditions.

Section 58. Rescuing of the Ships by the Icebreakers, as They Were Conducted Through the Ice.

In Section 10 of the Regulations for the ships conducted through the ice, has been provided that the ship following the icebreaker must, in case of damage, issue a signal of distress by the International Code of Signals. By the same regulations it has been established that neither the icebreaker, nor the owner of the icebreaker, not even the cargo owner are liable for the injuries and other losses which may be caused to the conducted vessel during the conduction and because of the conduction through the ice, and the maneuvers connected with the conduction. However, neither in the Regulations nor in any other legal enactment there is a clear provision in regard to the fact whether the icebreaker must aid the ship without charge, while the ship suffers distress when being conducted by the icebreaker.

Let us analyze one of the most characteristic decisions of the MAK, bearing on this matter. The Administration of a maritime port, disposed in the estuary of a river, applied to the MAK with the statement that it had made an agreement with the captain of the Greek steamship "VASILEOS POLEMIS", which was grounded on a shoal in the conditions of a drifting ice, and the rescuing agreement was completed on the prescribed form. The direction of the port assumed the obligations to rescue the ship and cargo.

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The operations dealing with the rescuing of the ship were effected by four icebreakers, two of which were conducting the ship in the ice at the time of the damage. The ship "VASILEOS POLEMIS" had to unload over to some other steamship and barge 1,600 tons of cargo, after which the distressed steamship was successfully taken off the shoals and was towed in the nearest seaport, which was free from ice. At the inspection in the port unimportant damage of the helm was detected in the rescued steamship. After their correction the cargo, unloaded from the steamship while it had been taken off the shoal was reloaded and the steamship "VASILEOS POLEMIS" continued her voyage according to her assignment.

In addition to the actual expenses spent for the ungrounding of the ship, the main office of the port submitted to the MAK (Maritime Adjustment Commission) a claim for the rescuing compensation. The owners of the steamship "VASILEOS POLEMIS" in their objection to the claim, declared that at the time of its grounding the steamship was under the guidance of the icebreaker "TOROS" which was in the possession of the claimant. Moreover, the icebreaker "TOROS" did not extend any aid to the steamship "VASILEOS POLEMIS" when it was grounded. To the extent that the rescuers themselves were guilty of the fact that the defendant needed aid, they had no right to compensation. Further, the owners of the steamship "VASILEOS POLEMIS" pointed out that neither their ship nor the vessels rescuing it were in a condition of immediate danger. Finally, the owners of the rescued ship declared that the expenses of the claims are exaggerated, since from their bill they should exclude all the expenses born by the rescuing ship in the port for fourteen days - from the day of the grounding of the ship on shoals to the day of signing of the rescuing agreement. It also would be improper, in the opinion of the defendant, to compensate the crews of the ships participating in the rescuing operations.

At the trial of this case the MAK had to entertain the following questions:

1. was the grounding on shoals by the steamship "VASILEOS POLEMIS" caused by the carelessness

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of the icebreaker "TOROS" as it was conducting the ship through the ice, or by some other causes;

2. was the rescued ship and the rescuing vessels threatened by some real dangers;

3. what work was done by the rescuers and what expenses were borne by them;

4. what is the price of the rescued property and what should be the ratio of the rescuing compensation.

As it had been established by the damage committee, the ships "KIEV" and "VASILEOS POLEMIS", after taking on their cargo, were ready to leave the port. In the morning dense fog prevailed both on the roadstead and in the channel. The steamer "KIEV" which was guided by an experienced captain, well acquainted with the local conditions, was ordered to leave the port on its own. Then the icebreaker "TOROS" by tagging on the steamship "VASILEOS POLEMIS" took after the steamer "KIEV". Passing by the steamer "KIEV", the captain of the icebreaker "TOROS" left the steamer "VASILEOS POLEMIS" which had to wait for the icebreaker's return. Thus it went ahead in order to make ice reconnaissance by its hull.

Being convinced that the ice in the channel could be easily passed through, the captain of the icebreaker "TOROS" ordered the steamer "KIEV" to proceed on its own, while the icebreaker itself returned to the steamship "VASILEOS POLEMIS", proceeding with its conduction.

After approximately six hours of sailing the icebreaker and the conducted ship reached the anchored steamship "KIEV" whose captain declared that because of heavy fog he cannot proceed on his course. The icebreaker "TOROS" sailed on and discovering that at a short distance ahead there is free water, it returned to the ships. But since there was a dense fog he advised them to stay on anchor, waiting for better visibility. Then the icebreaker "TOROS" came up to the steamer "VASILEOS POLEMIS" which anchored

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behind the stern of the steamer "KIEV", and upon the request of the pilot, in view of the drifting ice, shifted the steamer "VASILEOS POLEMIS" backward to the northern edge of the channel, after which the steamer dropped the port anchor.

Soon the northern edge of the channel was cleared of ice, but along the southern edge the ice kept staying on. To the aid of the icebreaker "TOROS" came up the icebreaker No. 4, which stopped behind the stern of the "TOROS" and "VASILEOS POLEMIS". The fog did not disperse, visibility was bad, and the ships thus remained in place until the next morning. Not figuring on the improvement of visibility in a short while, the captain of the icebreaker "TOROS" gave the disposition to get ready to resume the sailing. When the anchor was raised on board the steamer "VASILEOS POLEMIS" the icebreaker "TOROS" was at the head of the echelon, followed by the steamer "KIEV", then by the icebreaker No. 4 and finally by the steamer "VASILEOS POLEMIS". In so doing the steamer "KIEV" being in possession of a relatively small draft, stood not in the channel but behind its edge. The captain of the damaged ship at the trial indicated to the Commission that roughly in about an hour after the disposition of the icebreaker "TOROS" to get ready for departure at a distance of about 100 meters in the fog the steamship "KIEV" appeared as it was raising its anchor. Driven by a powerful current and under the effect of the drifting ice, the steamship "VASILEOS POLEMIS" started to move forward. The captain of the steamship "VASILEOS POLEMIS" testified that, seeing the unavoidable collision with the steamer "KIEV" he gave the engine full speed to the rear. The ship turned starboard and at the same time behind its stern a powerful knock was heard and a shake-up was experienced; the ship was grounded on a shoal and injured its helm.

Roughtly in the same way was described the grounding episode in the log book of the steamship "VASILEOS POLEMIS". Upon the question whether the steamship "VASILEOS POLEMIS" could have avoided grounding on the bank, bypassing the steamer "KIEV" if there were no movement of the ice, the captain of the damaged ship answered that in such conditions the steamship would have passed freely without tangling with

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the right-hand edge of the channel.

The explanation of the conditions in which the damage took place, as was offered by the captain of the steamship "VASILEOS POLEMIS" was at variance with the testimony of the pilot of this ship. The pilot testified at the time when the ship raised the anchor, the ice in the southern side of the channel unexpectedly started to move, while it stood still when the captain of the ice-breaker gave his orders to proceed with sailing. In order to stay on the spot the steamship gave full speed backward and was grounded on the bank. No efforts to bypass the steamer "KIEV" was made by the damaged ship, and no danger of collision with the steamship "KIEV" threatened him.

The testimony of the pilot of the steamship "VASILEOS POLEMIS" had been confirmed by the fact that the steamer "KIEV", with a draft of about six meters was stationed at that time not in the channel but behind the edge of the channel, in which a place whither the steamship "VASILEOS POLEMIS" with its eight-meter draft, could not come at all. The pilot of the steamship "KIEV" had categorically denied the possibility of collision of the steamship "KIEV" with the steamship "VASILEOS POLEMIS".

In the ship log of the icebreaker "TOROS" the following notation was made:

> "8 hours 40 minutes we set out to the steamship "KIEV" which was stationed in front. At 9.15 we set out by the channel, leaving behind the steamship "KIEV". The icebreaker No. 4 was given the order to lead toward free water the steamship "VASILEOS POLEMIS". There is no ice in the channel. At the southern edge the ice stands form".

The testimony of the pilot of the steamship "KIEV" was confirmed by the radio-telegraphic correspondence between the captains of the steamship "VASILEOS POLEMIS" and the icebreaker "TOROS". At 8.40 the captain of the steamship "VASILEOS POLEMIS" issued the following radiogram: "The ice moves, the ship is being carried away, I shall be pushed to the shoal". The captain of the icebreaker "TOROS"

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gave the following reply: "The icebreaker No. 4 is rushing to your aid". In this correspondence as we see, there is a reference to the movement of the ice, however there is no assumption of the danger of collision with the steamship "KIEV".

On the basis of all these data the MAK came to the conclusion that the danger of collision between the steamship "VASILEOS POLEMIS" and the steamship "KIEV" did not exist, and that the rear run by the steamship "VASILEOS POLEMIS" was given exclusively for the purpose of staying in one place, since at the time when the anchor was raised, the ice started unexpectedly to move along the southern edge of the channel. At the time of this maneuver the steamship "VASILEOS POLEMIS" ran aground.

The conditions of the grounding of the steamship as established by the MAK disclosed the absence of liability whatsoever on the part of the icebreaker "TOROS". As it can be seen from the materials of the case, the icebreaker "TOROS" had at all times serviced the steamship "VASILEOS POLEMIS" in good conscience. The service of the icebreaker "TOROS" was subsequently reinforced by icebreaker No. 4.

The text in the log of icebreaker No. 4 makes it clear that upon receipt of the order of the captain of the icebreaker "TOROS" to rush to the aid of the steamship "VASILEOS POLEMIS" it was at its side already in 15 minutes.

Thus, the statement of the defendant reporting that allegedly the rescuers themselves by their own actions made the rescue operations necessary, and therefore had no rightful claim to compensation, had been fully disproved.

Considering further the question of the degree of the danger which threatened the rescued ship and the rescuing ships the MAK remarked that the captain of the steamship "VASILEOS POLEMIS" in many of his radiograms as revealed through the testimony before the Damage Commission, and in the text of the log book has consistently stressed that the ship is threatened with serious danger. However, the MAK did not consider to base its findings fully on the materials submitted by the captain of the damaged ship and

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his testimony.

The captain of the steamship "VASILEOS POLEMIS" claimed that his vessel was threatened by the danger of collision with the steamship "KIEV", however this statement was fully disproved. The captain sent a radiogram to the ship owner in Athens about the injury to the helm by the icebreaker during its attempt to take the ship off the shoals, which did not correspond to the established facts.

The steamship "VASILEOS POLEMIS" was undoubtedly threatened by the danger since it was solidly grounded on a bank in the conditions of the drifting ice and could not get off the ground by its own force. In such conditions the rescuers are entitled to compensation in accordance with the Article 163 of the Code of Commercial Sea Navigation. However, the immediate danger of capsizing did not threaten the ship, and the captain of the damaged vessel was conducting for 14 days negotiations about the terms of rescuing, without signing the rescuing agreement. If the ship had been threatened with the danger of capsizing, the captain, quite naturally, would not dare waste much time and immediately would have signed the agreement.

The rescuing operations were initiated only after the signing by the captain of the damaged vessel of the rescuing agreement and were carried out by four icebreakers, in the group of which were the icebreakers "[illegible]" and No. 4, which were engaged in conduction of the damaged ship in the ice until it grounded on a bank. Taking into consideration that the rescuing took place on a relatively shallow bank in conditions of poor visibility and the drifting ice masses, the MAK recognized that the real danger was threatening also the rescuing ships.

Further, the MAK arrived at the conclusion that the rescuing operations were crowned with success. Also the amount of the rescuing compensation was determined, together with the expenses of the rescuers, which in accordance with the Sections Nos. 164, 168, 170, 171 and 172 of the Code of the Commercial Maritime Navigation, Sections 2, 6 and 8 of the Brussels Convention of 1910, Sections 14, 15 and 16 of

the instructions concerning the trial of cases by the MAK and Sections 3 and 8 of the Rescuing Agreement, have been claimed in proportion of the value of the ship, the freight and the load. The expenses connected with the trial have been assessed to both parties.

This case bears testimony to the fact that the ice-breakers engaging in the conduction of the ships through the ice lanes, in accordance with the effective legislation have under certain circumstances the right to receive the rescuing compensation from the ships in distress enjoying their conduction services.

Besides that, this case shows over again that the captain of the ship conducted by the icebreaker through the ice lanes, by carrying out the orders of the captain of the icebreaker connected with the movement of the ice masses, must take at the same time precautionary measures, for he is not relieved of liability for the safety of the ship which had been entrusted to him.

Section 59. The Rescuing of the Ships in the Conditions Where Complete Freezing Sets in.

In the practice of navigation cases took place when a ship was rubbed in by the ice masses during the ice floe in the fall. Especially dangerous in this case is the grounding of the ships on shoals in the estuary of a river. Many cases are on record when a ship grounded on a bank before the ice flow in the estuary of large rivers with rapid current, had been cut across by the ice. Therefore in the late season of the year before the ice flow starts, and the complete freezing sets in, one has to be especially careful. However, if the ship grounded at the same time on a bank, one should take measures immediately, so as not to waste a single hour, to get off the shoals by one's

forces and means available. Cases are known when rescuing took place in the absence of the ice, but foreseeing of the impending ice flow, and if the grounded vessel was not given immediate assistance, it could be lost. Similar situations took place when the steamship "RODINA" engaged in the rescuing of the English ship "STAR OF ADEN", which the MAK took cognizance of when trying this case and was determining the amount of the rescuing compensation.

The event took place under the following circumstances. The steamship "STAR OF ADEN" was grounded at the outlet from the estuary of the river with a load of milled products. The measures taken by same to getting off the shoals failed to give positive results, which made it necessary to plead for aid with the captains of the steamships "RODINA", "IGARKA", KATUN", and the diesel vessels "TALALIKHIN" and "IVAN SUSANIN".

The damaged ship had to be unloaded by about 1000 tons of cargo and the ballast water had to be pumped out, after which the rescuing vessels, their common effort, took the ship off the ground without any damage.

The owner of the rescued ship, motivated his negative decision in payment to the rescuing compensation that the "STAR OF ADEN" was not threatened by any danger. Besides this the defendant refused to bear the full amount of expenses which had been actually put in by the rescuers, since, by his way of reasoning, there was no need for the ungrounding of his ship by such a large number of ships. He considered that the rescuing operations could have been carried out by one or at best by two ships, but in the course of a longer period of time, so much the more since the vessel grounded on a sandbank in the estuary of a river no predicament threatened.

The Maritime Arbitration Commission (MAK) at the trial of this case did not agree with the opinion of the defendant. As it had been proved the steamship "STAR OF ADEN" was threatened with a real danger of shipwreck. From the moment of grounding and up to the time of its removal from the sandbar, the water surface in the river was reduced by 32 cm, and furthermore the water continued to decrease, which is the usual occurrence in this area before the complete freezing. Having grounded with the

central part of the hull, the steamship "STAR OF ADEN" at a considerable dropping of the water level, which actually took place, could break in two. Besides this, the delay with the removal of the steamship from the sandbar could have lead up not only to its wintering in the ice conditions, but also to its complete destruction from the accumulation of the ice masses, since before the setting in of the complete freeze and also in the spring time considerable masses of ice are delivered from the upper reaches of the river to the sea. On the other hand, the rescuing ships themselves had been subjected to the rear risk of being caught by the ice masses with all the consequences issuing therefrom, if they had not managed to retire to their bases disposed in the upper reaches of the river.

Thus, the Maritime Arbitration Commission (MAK) determined that the merit of the rescuers consist in the restoration of the seaworthiness of the damaged ship, the liquidation of the danger of its destruction, and the rescuing of the ship together with its valuable cargo. Taking into consideration the efforts, labors and expenses sustained by the claimants, the MAK guided by the Articles 171 and 172 of the Code of Commercial Maritime Navigation determined the rescuing compensation at the rate of 10% of the value of the risked property, that is, the ship and freight.

Section 60. Rescuing of the Ships During the Ice Drifts.

The rescuing tug "PERESVET", plying on its assigned course, received over radio distress signals of the maritime fishing trawler "MRT-1028" and promptly laid its course to the place of the mishap. As it further was brought out, the trawler proceeding on its way to the sea, ran into large fields of the floating ice about 50 cm thick, and decided to break through them. However, the fields

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accumulated and although they caused no injury to the hull of the trawler, but compressed it and dragged it along with the drift. All attempts of the trawler to get out from the icefields were not attended with success, while explosives were not available on board the trawler. Later as a result of heavy compression of the ice, the plating of the hull was torn off in the area of the forepeak and the stem was damaged at a length of about one meter.

Between the captains of the ship "MRT-1023" and "PERESVET" a rescuing agreement was signed. The rescuing operations which took place in heavy ice conditions, had been successfully completed. A cement box was placed at the injured section of the forepeak and the tug, after chipping off the ice all around the trawler, safely got it out from the ice tract.

However, the defendant, the owner of the trawler "MRT-1023", agreed to compensate merely for the factual expenses connected with the conduction of the ship through the ice drift, however, raised objections to the payment of the rescuing compensation on the basis that allegedly not the rescuing took place, but the ordinary towing. The captain of the trawler, according to the statement of the defendant, issued his distress signal by lack of experience; likewise, by his inexperience the signed rescuing agreement and the statement stating the termination of the rescuing operations was executed by him.

The defendant pleaded with the MAK to go by the conditions of the case indicating the fact that, in his opinion, the rescuring of the ship actually did not take place, since the ship was not in a damaged condition and did not suffer distress. These facts the defendant asked to be taken into consideration when the MAK will have made its decision known.

He also pleaded with them to take into consideration the fact that the operation connected with the proffering of aid took only one-half hour, and not four hours, as the claimant stated.

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The representative of the claimant, referring to Sections 164 - 168 of the Code of the Commercial Maritime Navigation insisted on the payment by the defendant of the rescuing compensation, and also for the expenses incurred during the actual time, in the course of which the rescuing operations had been conducted, since the vessel had been detracted from its course in order to proffer aid.

Taking into consideration the conditions in which aid was offered to the trawler "RRT-1028", and also the positive results of same, furthermore going by the Articles 164 - 168 of the Code of the Commercial Maritime Navigation, the MAK gave full satisfaction to the claimant.

As it had been indicated above, to anchor in the ice tracts and so much less in the drifting ice masses, is not axx advisable. Especially hazardous is the anchorage at the entrance of a bay, strait, harbor, covered with ice that is not solid, which may be carried in the sea under the effect of the wind or current. Still more dangerous is anchorage in the estuary of the river in the spring or late fall periods when the ice is brought in large masses by the river.

If the ship must anchor in such conditions, one should organize a special watch on the bridge of the 2nd mate. Besides this the engine must at all times be in full readiness. Any change of the course and direction of the wind and the drift of the ice masses, which at first sight do not even threaten the ship, must be immediately reported to the captain.

The steamship "VLADIVOSTOK" edgering one of the inlets covered with ice, dropped both anchors while waiting for the orders to enter the port for unloading. As the result of a strong wind which set in, the ice was carried out from the inlet. The watch assistant was at this moment in his cabin, while the watch sailor did not attach any special importance to the movement of the ice. As a result the ship was carried away with the drift of the ice masses.

During a heavy snow blizzard and at visibility of

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not over 50 meters at the stem of the steamship "VLADIVOSTOK" emerged the schooner "VEKHA" which also was carried by the ice in the open sea.

As it had later been established on the deck of the schooner there was no watch at all, so that the captain of the schooner found out about his being in the drift, only when it was already too late and impossible to take any measures. The schooner "VEKHA" dashed with his port side against the anchor chain of the steamship "VLADIVOSTOK" and then also against its stem. Upon request of the captain of the schooner "VEKHA" a storm trap was handed to the schooner from the steamer "VLADIVOSTOK" and the whole crew of the schooner was taken aboard the steamer.

The captain of both vessels signed the agreement about the rescuing of the schooner on the conventional MAK form. Due to the efforts of the crews of both ships and skillful maneuvering of the captain of the steamer "VLADIVOSTOK", the schooner "VEKHA" was moored to the lee side of the ship and in such position under the shelter of its hull, kept on until the ice drift stopped. At this time it had been discovered that the steamship "VLADIVOSTOK" lost its anchor. After this the schooner had been passed over to the towing launch, which towed it away in the port.

The captain of the steamship "VLADIVOSTOK" submitted to the owner of the schooner "VEKHA" a claim of about 35,000 rubles in which the price of the lost anchor was included, and also the charge for nine ship hours which allegedly had been spent for the rescuing of the schooner.

At the trial of this case the MAK determined that the schooner "VEKHA" had been threatened by real danger of being drifted into the open sea or be crushed by the ice masses. Only due to the aid obtained from the steamship "VLADIVOSTOK" the schooner had been saved. Thus, the fact of rescuing the schooner "VEKHA" and the useful results achieved by the rescuers were not subject to doubt.

However, the MAK did not agree with the claim of the claimant about indemnifying his time since up to the improvement of the weather the ship "VLADIVOSTOK" was deprived of

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the opportunity to unload or to carry out any other operations.

As far as indemnifying the price of the lost anchor is concerned, the Maritime Arbitration Commission (MAK) recognized the fact of the loss of the anchor during the rescue operations, as not proved. The MAK determined in the compensation for the rescuing of the schooner "VEKHA" in the sum of 15,000 rubles, but indemnifying the lost anchor and the cost of the operational conveniences of the ship, it declined.

It said example before all one must take note of the deplorable condition of the service on board the ship. The large ship "VLADIVOSTOK", due to the lack of attention on the part of the watch assistant, lost its anchor. while the schooner "VEKHA" was threatened with complete destruction.

In similar conditions in the estuary of a river the fishing boat "TONKERA No. 1" had been compressed by the ice masses and taken to sea. On board the ship the supplies of food were exhausted, the forepeak was damaged by the ice. The crew could not eliminate the onsetting and pernicious leaks because of the absence of cement, hemp, paint, lumber. The owner of the ship made an arrangement with the captain of the steamship "MOLODETS" toward the rescuing of the vessel and the steamship put out to sea in search of the distressed ship.

The search for the ship "TONKERA No. 1" continued for six days and was conducted in a difficult ice situation at extremely bad visibility, the wind of five to six ball force, in the drifting and hummocking ice masses.

Upon finding the distressed ship the steamer "MOLODETS" provided the crew with food and materials to stop the leaks in the forepeak. Thereupon it took it on tow, and in accordance with the agreement, brought it out in free water.

The claimant sued the defendant before the MAK demanding compensation forkxx the rescue of the ship and expenses

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incurred by the rescuer, and also 5% for indemnifying the expenses incurred for the action (in accordance with Note 1 of Article 46 of the GPK RSFSR).

The Maritime Arbitration Commission (MAK) determined that the sailing vessel compressed by ice masses and its crew being without food supplies, were under the threat of destruction and the actions of the steamship "MOLODETS" were attended by useful results. The ship was discovered after search, had been successfully taken out from the ice-bound area to free water; the lives of eight persons were saved and the ship was preserved, together with the cargo loaded in it. The MAK gave full satisfaction to the claim of the steamship "MOLODETS".

The ship of the local port fleet must be especially careful at the time of the coastal navigation while floating ice masses are at sea. The ship can suddenly turn its direction and the ship can be pushed out ashore by the accumulating ice masses and seriously damaged or even crushed. With the shore lead breaking off from the coast the small vessels can be drawn into drifts and carried in the sea. The sailing of small ships in the coastal crushed rarified ice is dangerous, since under the effect of the wind it can rapidly become solid and press the ship, damage its hull or drag it along into drifts.

A similar case took place with the launches "DZHIGIT" and "VARYAG". The chief of the port thought that the rarified ice masses could not cause any damage to the sufficiently strong metallic hulls of the launches and wooden kungas (hunting junks) while in tow, so much the more since the shipment was not over 5 - 6 hours.

The launches "DZHIGIT" and "VARYAG", [illegible] together with the kungases set out along the seashore on a trip. The ice was rarified and of the substance of two to three balls and did not suggest any dangers. However, three hours later the wind changed its direction and by the force of six or seven balls quickly made the ice masses solid. The launches and kungases were pressed in by the ice masses and taken to sea. The steamer "SIEVAN" set out to search for

the stranded vessels. In spite of the snow blizzard, poor visibility and the drift of the ice masses, the steamship "EREVAN" found the launches and got them safely in the port. The kungas boats /TN; kungas is oriental fishing boats/, were not discovered; obviously they had been crushed by the ice and buried in the snow.

The owner of the steamship "EREVAN" submitted a request to the Maritime Arbitration Commission (MAK) with the claim to have his actual expenses for the rescue operations refunded and a rescuing compensation granted, which the defendant refused to pay.

The MAK determined that the launches "IZHIGIT" and "VARYAG" had been in a dangerous situation and their rescue was the result of the useful actions of the steamship "EREVAN". Consequently, in accordance with the Article 164 of the Code of the Commercial Maritime Navigation, the claimant is entitled to get his rescue compensation.

Let us analyze the case which took place with the launch "KOZLOVSKIY". The steamship "VOYKOV" received a radiogram in which it was said that this launch was taken to the sea with the ice masses and is in need of immediate help. 25 men of the crew were on board the launch. The steamer "VOYKOV" instantly set out in search of the launch and the next day discovered it in the drifting ice masses. The launch was raised with a heavy winch on board the ship and delivered into the clear water, where there was no longer danger for it, after which the launch got safely to the point of assignment.

Only the factual expenses dealing with the rescue of the launch were about 25,000 rubles (without considering the rescue compensation) at the same time when the price of the launch itself was not over 20,000 rubles. When the case came up for trial before the Maritime Arbitration Commission (MAK) it was determined that on board the launch at the time of its rescue there was a cargo with estimated value of about 16,000 rubles. Considering the merits of the crew of the rescuing ship in the bad ice conditions, within which the rescuing operations were conducted, and

also the relatively small price of the rescued property, the rate of the rescuing compensation including the expenses of the rescuer was determined in the sum of 25,000 rubles.

Section 61. The Liability of the Charter Agents for the Good Quality of Icebreaker Conduction of Ships.

In the contract dealing with the chartering of the vessels which in the process of their navigation are meeting with ice masses, especial provisions are stipulated providing for the normal icebreaker aid. However, there is no indication in same as to the quality of the icebreaker conduction service. In the practice of the sea-going fleet problems of the quality of the icebreaker conduction and the liability connected with it on the part of the contracting parties, are frequently on record.

As an example let us dwell on the case described above dealing with the Greek steamship "VASILEOS POLEMIS", which applied to the Maritime Arbitration Commission (MAK) with the complaint of insufficient aid proffered to it by the icebreaker "TOROS".

In their pleading the owners of the Greek ship pointed out that in accordance with the contract the chartering agents were duty-bound to give the ship assistance of the icebreaker. However, according to the allegations of the owners of the ship, this aid was insufficient, and the steamer went through a damage due to the carelessness of the icebreaker "TOROS". Seeing in the carelessness of the icebreaker the violation by the freight agent of their obligations, the shipowners demanded from the charter agent the compensation of all the losses caused by the

damage, that is, of all the expenses dealing with the repair of the ship injuries, the return of the compensation for rescuing, the losses suffered through the waste of time, etc.

In his objection to the demands so stated the chartering agent declared that by the tenor of the contract he is not liable for the quality of the icebreaker aid offered to the conducted vessel. (Independently from this, as we know, the steamship "VASILEUS POLEMIS" was given the proper icebreaker aid while the damage took place due to other causes).

In connection with the the Maritime Arbitration Commission thoroughly considered two problems:

1. what is the exact content of the obligation to bestow icebreaker aid as assumed by the chartering agent;
2. has/the instant case the icebreaker "TORUS" been careless?

By the provisions of Section 2 as stipulated in the freight congract, the freight agent is under obligation to take measures toward the duty that the icebreaker be not later than 48 hours at the place of the ice edge, when taking the vessel to the port, and when taking it out of the port not later than 48 hours after the captain gave his notice. Thus the chartering agent assumes the liability for the timely bestowal of the icebreaker aid.

The aid itself is at the disposition not of the chartering agent, but of the organization which is in charge of the icebreakers, that is, of the chief of the corresponding port. In Section 1 of the Regulations governing the ships conducted through the ice it is stated that with the request to place the icebreaker at the disposition of the vessel one has to apply, while in the port, to the chief of the port, and while at sea, - to the captain of the icebreaker. By the provisions of Section 4 of these

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Regulations the time and order of sequence of the vessels through the ice. and also the number of the simultaneously conducted vessels, is being determined while in the port, by the chief of the port, and while at sea - by the captain of the icebreaker. In accordance with Section 5 of the regulations the captains of the vessels following the icebreaker in the ice, in matters bearing on the movement in the ice, must submit to the orders of the captain of the icebreaker. Furthermore, in Section 15 of the regulations it has been prescribed that each vessel enjoying the services of the icebreaker for conduction through the ice, by this same fact declares its willingness to submit to the regulations.

As much as the time and order of sequence of the vessels conducted through the ice, are determined by the chief of the port or captain of the icebreaker, from the moment on that the ships have entered under the jurisdiction of the icebreaker, between the conducted vessel and the icebreaker conducting it, directima relations are established, to interfere with which the chartering agencye is not only not entitled to, but actually has no opportunity whatsoever.

Alongside with this by directing its ship in the freezing ports, the ship owners are getting increased freight rates. The difference between the freight rates in the freezing and non-freezing ports is the compensation for this risk, which the ship owner assumed when sending his ship in the ice blocked regions.

Taking under advisement the claim of the Greek steamship, the Maritime Arbitration Commission (MAK) arrived at the following conclusions:

> It is the duty of the chartering agent to provide the chartered vessel with the assistance of the icebreakers, and this assistance must be placed at their disposition in proper time;
>
> the assistance given by the icebreaker must be such that it usually is proffered in a certain sea or in a certain port, while its order of sequence and the mutual relations of the ships with the ice-

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breakers are regulated exclusively by the Regulations governing the conduction of the vessels through the ice;

the risk of dangers threatening the ship during its conduction through the ice rests on the ship's owner.

On the basis of documents submitted by the parties to the suit, and upon depositions of same, the Maritime Arbitration Commission (MAK) determined that the icebreaker had taken all the measures for the proper and undamaged conduction of the vessel. Setting out from the facts already established, the arbitrators recognized that the chartering agents had not made themselves liable for any violation of the obligations assumed. In connection there with the Maritime Arbitration Commission ordered to deny the claim of the owners of the Greek ship "VASILIOS POLEMIS" as presented to the chartering agent.

SUPPLEMENT 1.

CLASSIFICATION AND TERMINOLOGY OF THE ICE VARIETIES MET WITH AT SEA

I. SEA ICE

A. The Age and Stage of Development of the Ice.

I. The ice varieties of the incipient types.

1. Ice needles.
2. Ice slush.
3. Ice sludge.
4. Slush.
5. Bottom ice (internal).
6. Ice rime varieties (young ice formation).
7. Pancake ice.
8. Glass ice (glare ice).
9. Ice crust.
10. Dark ice crust.
11. Light ice crust.

II. Gray Ice Varieties.

12. Gray young ice.
13. Gray-white young ice.
14. White ice.
15. One year (annual) ice.
16. Two-year old ice.
17. Ice of many years standing.

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III. The Ice of Many Years Standing in the Polar Seas.

16. The Arctic pack ice.

B. MOBILITY OF THE ICE

I. The Immobilized Ice.

1. Pack ice.
2. Coast ice (shore ice) /Shore lead/.
3. The ice foot of the fast ice.
4. The edge of the fast ice.
5. Stranded hummock (Krupnobityy).
6. Standing ice (Stoyak) .
7. Ice washed ashore (shore ice wall).
8. The drifting floe.
9. Ice fields.

II. The Drifting Ice Floe

a) Ice fields.

1. Extensive ice fields.
2. Large ice fields.
3. Small ice fields.
4. Debris of ice fields (floe).

b) Broken ice.

5. Large glasecone (large size ice slabs).
6. Small glasecone.
7. Debris.
8. Brash ice (slab ice).
9. Floeberg.

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c) Distribution Forms of the Drifting (Floating) Ice.

10. Ice massive.
11. Ice belt.
12. Ice spot.
13. Ice tongue.
14. Ice tract.
15. Ice dam.
16. Ice edge.
17. Consolidated edge.
18. Rarified edge.
19. The limit of the ices of various types.

d) Density or Consolidation of the Drifting Ice.

20. The ice is absent (water is clear).
21. Rare ice.
22. Rarified ice.
23. Consolidated ice.
24. Exceptionally consolidated ice.
25. Pack ice.

C. THE DEGREE OF ICE COMPRESSION

1. Exceptionally compressed ice.
2. Compressed ice.
3. Ice in thawing.

D. STRUCTURE OF THE ICE COVER

1. Smooth ice.
2. Laminated ice (stratified ice).
3. Outpouring icing.
4. Ice formed from refreezing of pools or lakes of older ice.

F. CRACKED ICE

a) Varieties of Cracks.

1. Dry cracks.
2. Open cracks in the ice cover.

c) The Divisions of the Cracks by Their Origin.

3. Tidal cracks.
4. Thermic cracks.
5. Dynamic cracks.

G. HUMMOCKY FORMATIONS

1. Blocks of underwater parts.
2. Single, small hummocks piled up edgewise (Ropak).
3. Hummock.
4. Bank of hummocks.
5. A hummock barrier.
6. A hummock belt.
7. A regular hummocky formation.
8. Rafted ice.
9. Ice piller (cushion).
10. Level ice.

H. CONDITION OF THE ICE SURFACE

1. Snow-free ice surface.
2. Slightly snow-covered.
3. Snowed under ice.

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I. CONDITIONS OF THE SNOW COVER

a) The Ages of the Snow Cover.

1. A recent snow cover.
2. An aged snow cover.

b) Various Forms of Snow Cover on Ice.

3. A level snow cover.
4. A ruffled snow cover.

c) Aspects of the Snow Formation.

5. Snow bank.
6. Wind-swept snow.
7. Undulation, wave, ripple, parallel ridges of snow formed by the wind.
8. Stratified snow.

J. Soiled Ice.

1. Clear ice.
2. Dirty ice.
3. Rime on the ice.
4. Salt colors on the ice.

K. STAGES OF THE ICE THAWING AND VARIETIES OF THAWED ICE"

a) Marks of the Ice Thaw.

1. Snow water.
2. Spots of wet ice.
3. Puddles on ice.

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4. Pools.
5. Clear water on ice.
6. Hole caused by thawing of snow.
7. Watery shore lead.
8. Open shore lead.

b) Varieties of Thawed Ice.

9. Lace-shaped ice.
10. Dried ice.
11. The ice sand.
12. The rotten (thawed) ice.

c) Varieties of the Thawing Ice.

13. Mushroom-shaped ice blocks.
14. The ice block with an underwater ram.

II. THE DRY LAND ICE

A. IMMOBILIZED CONTINENTAL ICE

1. The table-shaped iceberg.
2. The pyramidal iceberg.
3. Dark or striped iceberg.
4. Iceberg in decomposition.
5. Debris of the iceberg.
6. Iceberg pieces.

B. THE DRIFING ICE ISLANDS

/NOTE: The drifting continental islands settled on the ground should be classified as immobilized varieties of ice.

III. PHENOMENA CONNECTED WITH THE PRESENCE OF THE ICE AT SEA.

a) Water Between the Ice Masses.

1. Clear water.
2. Bay or bight in the ice.
3. Pools.
   Pools near estuaries.
   Pools near the shore.
   Fast ice pools.
4. Tidal leads.
5. Rarification zone.
6. Pool (glade).
7. Cracks caused by the current.
8. Channel.

b) Signs of Distant Ice Masses and Water.

1. Ice lake.
2. Water reflecting the sky /Skyblink/.
3. The ice sublimation.
4. Fog over the ice surface.

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SUPPLEMENT 2

REGULATIONS FOR THE SHIPS CONDUCTED BY THE ICEBREAKERS THROUGH THE ICE

Sec. 1. Request for conduction of the vessels through the ice must be directed in the port to the Chief of the Port, and at sea to the captain of the icebreaker.

Sec. 2. On board the ship subject to conduction there must be, within the limit of the demands of the navigation practice: a supply of coal and food sufficient for the passing through the ice tracts, together with the logs, quick cement, plaster, masts, and the like. The water eliminating means of the vessel must be in good condition and, besides this, the ship must have a radio set receiver in good condition.

In case such conditions have not been complied with and in addition, if the ship does not have by legal process and not overdue credentials by the government agencies or classification organizations about the seaworthiness, the chief of the port, and when the icebreaker is stationed outside of the limits of the port - the captain of the icebreaker has the right to refuse to take the ship to the area or to bring it in the port.

Sec. 3. Every ship in need of conduction by the icebreaker, must wait for the arrival of the latter and not enter the ice without the icebreaker.

Sec. 4. The time and order of sequence of the ships in their passage through the ice and also the number of the ships simultaneously conducted, are determined in the port by the chief of the port, and at sea by the captain of the icebreaker.

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Sec. 5. The captains of the vessels conducted in the ice by the icebreakers, must submit to the orders of the icebreaker with reference to sailing in the ice, and act in harmony with these orders.

Sec. 6. The ships sailing behind the icebreakers must not bypass each other.

Sec. 7. The ships while following the icebreakers, must be ready to reverse instantly their full speed run.

Sec. 8. The ships sailing in the ice with the aid of the tow cables of the icebreakers, must not give their engine the forward run without especial orders of the captain of the icebreakers on each occasion. They must be steadily prepared to drop the towing cable by the first demand of the captain of the icebreaker, and also to give full speed reverse run.

Sec. 9. In the first place naval vessels are conducted, then mail-carrying and passenger-carrying ships and the ships with such a cargo with reference to which there were special indications as to their urgency, and then all the other ships in order of their arrival to the ice edge or to their readiness to leave the port.

Sec. 10. The vessel following immediately after the ice-breaker, must, in case of damage, raise the distress signal by the International Code of Signals.

Sec. 11. The ships following the icebreaker in the ice channel, must go by the signals given with whistles or sirens. All the signals, with the exception of signal 6[1] must be repeated by the

Footnote 1. See Table 6 on page 112.

following vessels successively, beginning with the ship closest to the icebreaker, which gave the signal.

The orders of the icebreaker, issued with the signals, must be executed immediately.

Sec. 12. In case the captain of the vessel which proceeds under conduction efforts of the icebreaker, fails to carry out the dispositions of the icebreaker's captain, the latter may refuse to further conduct the ship until the full execution of the order.

Sec. 13. Neither the icebreaker, nor the owner of an icebreaker, nor the contracting agent are liable in a compensatory order for damage and other losses which may be caused to the conducted ships at the time and due to its conduction through the ice channels and because of maneuvering connected with this conduction operation.

Sec. 14. The merchant vessels of all flags can use, free of charge, the services of the icebreakers of the pertinent port directions in being conducted from the ice edge to the port and from the port to the sea, for conduction within the limits of the port basin, and likewise for the towing during the conduction, should such towing be recognized as necessary by the captain of the icebreaker.

The overmooring of the ship, connected with the execution of the loading - unloading operations, coal intake, taking in the docks, etc., must be carried out for compensation established for the use of the corresponding services.

Sec. 15. Every ship using the services of the icebreaker for conduction through the ice, declares thereby its agreement to submit to all the regulations of the present by-laws.

Sec. 16. All the rules governing the conduction of the ships by the icebreakers, which have been operating before in any of the ports of the USSR, are cancelled with the publication of the present regulations.

NOTES: 1. The sound signals for bypassing in the ice remain the same as those specified in the rules for preventing the collision of ships at sea: one short "I go to the right", - two short ones - "I go to the left", - three short ones - "the engine is reversing its run".

2. When sailing in thick fog, mist, in snowfall, the signals described in the Article 15 of the Regulations for Averting Collisions of Ships at Sea, should be used.

3. The icebreaker should be considered as a leader of the echelon, which sails in front of one or several ships.

4. A dash is equivalent to a long sound, a dot is expressed by a short sound (see the Regulations of the International Code of Signals, or the Regulations for Averting Collision of the Ships at Sea).

5. At simultaneous work of several icebreakers the senior is the one whose engine plant is the stronger; its orders are carried out by the other icebreakers, unless different dispositions are issued by the chief of the corresponding port.

In cases when the signals given by the ship whistle are not heard because of the heavy wind, because of the adverse direction of the wind, or because of the great intervals of distance between the ships, in place of the sound signals, the flag signals or remote figures are used.

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In this case:

the balls or flags raised to their proper place, mean "I proceed forward, follow me";

the balls or flags, raised to half the height, - "Reduce your speed";

the removal of the ball or flag stands for "Stop following me, remain where you are".

All the other signals are transmitted by radio or by the flag semaphore.

During the time of night signaling the messages are transmitted by the lit Morse lanterns and sometimes even by the flashlight.

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SUPPLEMENT 3

LIST OF COUNTRIES PARTICIPATING IN THE EXPENSES FOR MAINTENANCE OF THE SERVICE DEALING WITH THE INVESTIGATION OF THE ICE CONDITIONS, THE STUDY OF THE SITUATION AND OBSERVATION OF THE ICE MOVEMENTS IN THE NORTHERN ATLANTIC

Name of country.	Participating in the expenses in % of	Name of country	Participating in the expenses in % of
Belgium	2	Netherlands	5
Great Britain and Northern Ireland	40	Norway	3
Germany	10	USSR	1
Denmark	2	USA	18
Spain	1	France	6
Italy	6	Sweden	2
Canada	3	Japan	1

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SUPPLEMENT 4

THE MARITIME ARBITRATION COMMISSION ATTACHED
TO THE USSR CHAMBER OF COMMERCE IN MOSCOW

RESCUE AGREEMENT

(Standard Form)

"WITHOUT RESCUE OPERATIONS THERE IS NO COMPENSATION".

19 ____________ year

The present agreement is entered into between the captain ______________________ of the steamship (motorship) ______________________

Owned by ______________________

Named in the text "Captain", and rescuer ______________ in the persons of ______________________

Named in the text "Rescuer", on the following subject:

1. The "Rescuer" takes upon himself the execution of operations aiming at the rescue of the steamship (motorship) ______________, of the cargo loaded in same, and other items of property, and also to conduct the said vessel to ________ ______________ or some other port by agreement with the "Captain".

2. For execution of the rescuing operations "the rescuer" can use, free of charge and in the proper way, the mechanisms, chains, anchors and other installations

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of the rescued vessel without causing damage, without need, not casting them away and sacrificing them, nor with any other kind of the vessel's property.

3. For the execution of the operations provided in Section 1 of the present agreement, the "rescuer" in case of successful results of rescuing will get the compensation in the sum of ________________ of at the rate determined by the Maritime Arbitration Commission attached to the USSR Chamber of Commerce in Moscow (Kuybysheva, Street 6).

If the rescuing operations, in spite of the effort of the "rescuer" are conducive to only a partial result, the "rescuer" will have the right to obtain compensation in the measure corresponding to the results achieved.

If by agreement of the parties to the contract a certain determined sum of compensation "for the rescuer" will be provided, nonetheless this sum can be debated by each of the parties, and likewise by other interested persons (Section 11).

In such case the ratio of compensation for rescuing will be established by the Maritime Arbitration Commission with the observation of the terms of the present contract.

The Maritime Arbitration Commission will also settle all the other disputes between the parties arising from the present agreement.

4. The "rescuer" has the pawning rights on the rescued property to the sum of the required compensation for rescuing. Without the written authorization of the "rescuer" or without the disposition of the chairman of the Maritime Arbitration Commission, the rescued property cannot be moved from the place provided in the first section of the present contract.

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5. If the "rescuer" wishes to secure his claim under the present contract he must report to this effect to the Maritime Arbitration Commission immediately after determination of the rescuing operations or before, by indicating the sum of the required security.

The ratio and form of securing the claims of the "rescuer" area determined by the Chairman of the Maritime Arbitration Commission by his findings, while the data of the conditions of the rescue operations are taken into consideration, together with the value of the rescued property and of the sum of the rescuer's expenses.

6. In case the claim for security is not submitted in due time determined by the Chairman of the Maritime Arbitration Commission, the "rescuer" may secure his pawning rights and sell the rescued property in order to satisfy his own demands for compensation for the rescue, as provided by law.

7. When submitting the report to the Maritime Arbitration Commission, about the impending arbitration trial, the interested party points out the desirable arbiter from the number of the members of the Maritime Arbitration Commission.

The Maritime Arbitration Commission notifies the other party about reception of such statement and gives it 30 days for appointment of a desirable arbiter from among the members of the Maritime Arbitration Commission.

If in said period the party does not appoint a desirable arbiter, then the Chairman of the Maritime Arbitration Commission, through request of the other party, appoints an arbiter from among the members of the Maritime Arbitration Commission, by its own decision.

Through mutual agreement the parties of the issue

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may submit the personal selection of arbiters to the care of the Maritime Arbitration Commission. In this case the Chairman of the Maritime Arbitration Commission may charge with the solution of the issue one particular arbiter, appointed from among the members of the Maritime Arbitration Commission.

8. The order of the arbitration proceedings is determined by the regulations governing the processing of cases by the Maritime Arbitration Commission, further confirmed by the presidium of the USSR Chamber of Commerce.

9. By the request of the "rescuer" the Chairman of the Maritime Arbitration Commission is entitled to issue orders, up to the final decision of the issue, in regard to the payment to the "rescuer" of the actually incurred expenses in full or in part and impound for this purpose in case of necessity, the corresponding part of the security that has been submitted.

10. The "Captain" enters into the present agreement in his capacity of the representative of the ship and freight and thereby of their owners, and is making each of them liable (without the liability of one for the other and without the personal liability of the captain) to the proper execution of the present contract.

11. The assignment of the arbitration process can be requested by: 1 - ship owners, 2 - the rescuers, and 3 - other persons interested in the rescued property in their capacity as freight owners, or insurers under the condition that their interest will constitute in the overall value of the ship and its cargo not less than one-fourth of the price of the rescued property.

The arbitration procedure can be assigned also by the disposition of the Chairman of the Maritime Arbitration Commission in a case when the claims of the "rescuer" have been secured in the order provided

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in Section 5 of the present contract.

12. If the parties to the issue wish to participate in the arbitration proceedings personally or through their representatives, they must notify of this the Maritime Arbitration Commission by indicating their address in the USSR, to which the notifications, summons, etc. should be addressed to them. If such communication had not been made by the party, all the information, summons and others addressed to this party, will be left in the Secretariate of the Maritime Arbitration Commission and will be considered as properly handed in.

13. Any disposition or any documents signed by the Chairman of the Maritime Arbitration Commission or by its deputy, and likewise any notifications, summons or communications signed by the Secretary of the Maritime Arbitration Commission, by order of the Chairman of the Maritime Arbitration Commission, will be considered as properly executed in the name of the Maritime Arbitration Commission.

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BIBLIOGRAPHY

AVRAAMOV, N. YU. Maritime practice, Article II. Handling of the barges, the Military - Naval Publishing House, 1938. Moscow - Leningrad, and the Military - Naval Publishing House, 1940.

AVRAAMOV, N. YU. and PODVYSOTSKIY, B. M. The Maritime Practice, Part III, "Executing the ship maneuvers". The Military - Naval Publishing House, Moscow - Leningrad, 1939.

AVRAAMOV, N. YU., PODVYSOTSKIY, B. M. and [illegible]SA, A. A. Maritime Practice, Part IV. "Struggle for the seaworthiness and keeping of the ship in working order. Loading and unloading of freight". Military - Naval Publishing House of the National Military - Naval Fleet, USSR. Moscow - Leningrad. 1939.

ALEKSEEV, M. P. Siberia in the reports of the western European travelers and writers, Section I, Irkutsk, 1932 - Section II, Irkutsk, 1936.

AL'TBERG, V. YA. The bottom ice. Leningrad, 1931.

ANTONOV, V. S. Electrically driven ship for the conquest of the Arctic. The water & transportation numbers 2 and 3. March - February, 1933.

ARNOL'D-ALYAB'EV, V. I. About some properties of the ice cover of the Bay of Finland, by the data gained by observation from aboard the icebreakers. Notes on hydrography, Volume 49, Leningrad, 1925.

ARNOL'D-ALYAB'EV, V. I. The icebreakers, their work and peculiarities, the Maritime Collection, No. 2, February, 1925.

ARNOL'D-ALYAB'EV, V. I. Navigation in the ice conditions of the Bay of Finland and the Baltic Sea under the

STAT

conduction of the icebreakers (from the practice of recent years). The Maritime Collection No. 10, 1924.

BELOUSOV, M. P. The tactics of sailing in ice conditions. The Main Office of the Arctic Sea Lines, Moscow - Leningrad, 1940.

BELOUSOV, N. A. and TAIROV, D. E. Let us build diesel electrical icebreakers. The Soviet Arctic, No. 4, Leningrad, 1936.

BERG, L. S. The discovery of Kamchatka and the expedition of the Bering. Publishing Institute of the USSR Academy of Science. Moscow - Leningrad, 1946.

BERG, L. S. Reports on the Bering Strait and its coast down to Bering and Kuka, - Notes on Hydrography, XI, V. O. 1919. Volume II, Fasc. 2.

BEREZKIN, V. S. The trip of "LITKE" in 1934. The Maritime Collection, No. 2, 1934.

BLAGODAREV, S. The possibility of a winter campaign. The Maritime Collection, No. 2, 1925.

BRUNS, P. P. Observations made on the processes of ice formation and melting. Transactions of the Arctic Institute, Volume 83, 1937.

BUNKIN, N. A. and YABLONOVSKIY, I. M. Struggle with the freezing of bodily parts. The National Publishing House. "Physical Culture and Sports", Moscow, 1942.

BURKE, A. K. Periodicity in the ice conditions. Sovetskaya Arktika, No. 5, Moscow - Leningrad, 1936.

BURKE, A. K. The Maritime Ice Masses. Moscow - Leningrad, 1940.

POOR COPY

STAT

BURKHANOV, V. F. New investigations of the Soviet scholars in the Arctic, "PRAVDA". May 16, 1954.

BUTSINSKIY, P. N. Mangazeya and the Mangazeyskiy District (1601 - 1945). "Transactions of the Khar'kovsk University", 1893.

VAKSEL' S. V. The Second Kamchatska Expedition of Vitusa - Bering, Leningrad-Moscow, 1940.

VAYNBERG, B. P. The ice, the emergence and vanishing of the ice. A collection of articles contributed with participation of AL'TBERG, B. YA., ARNOL'D-ALYAB'EV, V. I., GOLOVKOVA, M. P. GORLENKO, S. M., DOBROVOL'SKI, A. F., KAZANSKI, A. F., MIRCHINKA, G. F., SUMGINA, M. I., TIKHOMIROV, E. I., SHEPELEVSKI, A. A., Moscow, 1940.

VERMANDER, S. The steam mechanisms for vessels sailing in the ice-locked areas. Novosti Tekhniki (Technology News), No. 63, 1934.

VINOGRADOV, I. V. Ships fitted for Arctic navigation. The Defense Publishing House, 1946.

VINOGRADOV, I. V. The type of the oil fuel ships for navigation in the ice conditions. Sudostroenie (The Shipbuilding) No. 4, 1937.

VIZE, V. YU. Hydrological sketch of the Laptev and Eastern Siberian Seas. Materials of the Committee charged with the study of the Yakutkoy Socialist Soviet Republic, Fasc. 5, 1926.

VIZE, V. YU. The Seas of the Soviet Arctic, Glavsevmorput' (Main Office of the Northern Sea Route), Moscow-Leningrad, 1948.

VIZE, V. YU. History of investigation of the Soviet Arctic, Arkhangelsk, 1935.

STAT

POOR COPY

STAT

VIZE, V. YU. Scientific work on board the "SIBIRYAKOV", Vodnyy Transport, (Water Transportation), March - February, Moscow, 1933.

VORONIN, V. I. The Stalin project, Sovetskaya Arktika (Soviet Arctic) No. 12. 1939.

VOYTKEVICH, M. The icebreaker operations in the German setting, St. Petersburg, 1913.

VRANGEL', V. Sketches from the Biography of S. O. MAKAROV, Morskoy Sbornik, (Naval symposium), Issues Nos. 3 and 5, 1913.

The provisional regulations for the ships conducted by the icebreakers of the Main Office of the Arctic Sea trips, through the ice tracts in the White Sea, 1944.

Provisional instructions governing the flights in ice reconnaissance, Glavsevmorput' (the Main Office of the Arctic Sea Navigation), Moscow, 1941.

GAKKEL', YA. YA. Instructions for carrying out observations on the movements of the ice from board the ship, Publications of AHII GUSMP, (the Main Office of the Northern Sea Route), Moscow, 1944.

GAKKEL', YA. YA. During a quarter of a century, Glavsevmorput' (Main Office of the Northern Sea Route), Moscow - - Leningrad, 1945.

GAKKEL', YA. YA. One quarter of a century. The Main Northern Sea Route. Moscow - Leningrad, 1945.

GEL'MERSEN, P. V. The Maritime Practice. Editorial Publishing House of the Navy. Leningrad, 1924.

GORDEYEV, V. K. Symposium of the Scientific Results of the Expedition on Board the "CHELYUSKIN" and in the camp of SHMIDT, Leningrad, 1938.

STAT

POOR COPY

STAT

GORDON. Heavy duty icebreaker with the settling deck for the Main Office of the Northern Sea Route (Sudostroenie) Ship Construction. Issue No. 10, 1935.

GORDON. Designing of the hull of an icebreaker for the Main Office of the Northern Sea Route, Novosti Tekhniki (Technology News), Issues Nos. 56 and 57, 1934.

GUREVICH, G. E. Organization of the shipment and freight operations on a sea freighter, Morskoy Transport (Maritime Transportation), 1952.

DAVYDOV, V. V. The solidity of the Icebreakers, Sudostroenie (ship construction) No. 2, 1937.

DeFEN. Navigation of Barents Sea, Leningrad, 1936.

DUBROVIN, A. The problem of construction of the northern ships, the Naval Symposium, No. 6, 1934.

EVGENOV, N. I. Considerations regarding the top limit draft of powerful icebreakers navigating along the northern maritime route; symposium of articles in hydrography and sea navigation. Hydrographic Office of the Northern Maritime Route No. 1, Leningrad, 1934.

ELAGIN, S. I. History of the Russian Navy, St. Petersburg, 1864.

ZHITKOV. The City of Mangazeya and the commercial route through Yamal. Natural Science and Geography, No. 5, 1903.

ZHITKOV. An historical survey of the laying out and caretaking of the waterways and ports in Russia throughout the century of 1798 - 1898. St. Petersburg, 1900.

STAT

ZUBOV, N. N. The ice masses of the Arctic, Glavsevmorput (Main Office of the Northern Maritime Route), Moscow - Leningrad 1945.

ZUBOV, N. N. Some properties of the sea ice. Publishing House of the Main Hydrometeorological Committee of the USSR and the Russian Socialist Federative Republic, Moscow, 1932.

ZUBOV, N. N. Foundations for the laying of railroads on an ice cover. Hydrometeorological Publishing House, Moscow, 1942.

ZUBOV, N. N. In the center of the Arctic. Glavsevmorput (the Main Office of the Northern Maritime Route), Moscow, 1948.

Instructions governing the hydrometeorological observations on board the ships, with the forces of the navigators' crews. Hydrometeorological Publishing House, Moscow, 1941.

The study of the icebreaker operations in the sea ports of the USSR. The transactions of the Scientific - Technological Committee of the Peoples Commissariat of Communication Lines. Issue No. V, Leningrad, 1925.

KAMENSKIY, S. T. Certifying and repair of the ship hulls. Morskoy Transport (Maritime shipping), Moscow, 1940.

KALACHEV, YA. N. Shipment of cargo on sea. Moskoy Transport (Maritime Shipping), Moscow - Leningrad, 1951.

KILESSO, A. Powerful icebreaker-barges. Moskoy Flot (Merchant Fleet). Issues Nos. 5 and 6, 1945.

A book on the maritime statute, the Naval Noblemen's Maritime Academy, St. Petersburg, 1724.

POOR COPY

STAT

KOLESNIKOV, A. P. About the speed of ice growth at sea. Problems of the Arctic. Issue No. 9, 1940.

KOMAROVSKIY, A. N. Strucgure and physical properties of the ice cover of the (fresh) waters, Moscow, 1932.

KONOVALOV, I. M., EMEL'YANOV, K. S., ORLOV, P. N. Foundations of the ice technology of the river transportation. Publication of the Ministry of the River Fleet of the USSR, Moscow - Leningrad, 1952.

KUSHNAREV, V. A. Taking care of the hulls, premises and ship installations of the steel vessels. The food promotion publishing house, Moscow, 1941.

KUSHNAREV, V. A. Navigation at sea in the ice-locked tracts. Rybnoe khozyaystvo (Fish Economy), Issue No. 11, 1952 and Issue No. 1, 1953.

NOGID, L. M. Problems of the modern Soviet icebreaker construction, Sudostroenie (Ship construction), Issue No. 6, Gosstroyizdat (National Construction Publishing House), 1934.

NOGID, L. M. Solidity of the vessels engaging in Arctic Navigation, Novosti Tekhniki (Technology News), Issues Nos. 56 - 57, 1934.

LAKTIONOV, A. F. Properties of the sea ice. Transportation Institute devoted to the study of the North, No. 49. 1931.

LAPPO, S. D. A pocket guide of the Polar worker, Glavsevmorput', (Main Office of the Northern Maritime Navigation), Moscow - Leningrad, 1945.

LEVANEVSKIY, L. A. ~~and~~ MAKAROV, S. O. and the Conquest of the Arctic. Publication of the Main Office of the Northern Sea Route, Moscow, 1940.

STAT

POOR COPY

STAT

MAKAROV, S. O. "ERMAK" in the ice-bound areas. St. Petersburg, 1901.

MAL'MGREN FIN. The properties of the sea ice, translation from English. Moscow, 1930.

MENDELEEV, D. I. Investigation of the Northern Polar Ocean. Reports submitted on the 14th of November 1901 to the Museum of D. I. MENDELEEV, serial No. 1044/79.

OBOL'YANINOV, M. M. Navigation in the ice-bound areas and the basic problems connected therewith. Sudostroenie (Ship construction), Issue No. 7, 1933.

General and specific rules governing the shipment of the cargo, passengers, baggage and freight-baggage over the maritime communication route on board the vessels of the MMF of the USSR, Part 1, Morskoy Transport (Maritime shipping), Moscow - Leningrad, 1949.

OLCHI-OGLU, N. Condition and the growth in the armament at sea in the capitalistic countries (Icebreakers of the Coastal Defense of the USA), Sudostroenie (Ship Construction), the Gosstroyizdat (The National Construction Publishing House), Issue No. 8, 1934 and 1935.

ORLOVSKIY, A. K. Establishment of the standard of solidity of the ship hulls in the conditions of sailing in ice-bound areas. Transactions of the TSNIIVT (Central Water Transport Scientific Research Institute), Issue Nos. 95 and 154, Leningrad, 1934 - 1935.

OSTROVSKIY, B. G. The great Arctic Expedition, 2nd Edition, Arkhangelsk, 1937.

A sketch of the Russian Maritime History, Part 1, St. Petersburg, 1875.

STAT

Regulations governing the technical operations of the ships of the Maritime Fleet, Morskoy Transport (Maritime shipping), Moscow - Leningrad, 1953.

Regulations governing the transportation of passengers, baggage and freight of the Maritime shipping of the USSR. Publishing House of the Peoples Commissariat of Water Transport, Moscow, 1935.

Regulations governing the classification and construction of the maritime steel vessels, the Maritime Register of the USSR, Morskoy Transport (maritime shipping), Moscow - Leningrad, 1952.

Regulations governing navigation on the interior waterways of the USSR, Rechizdate (River Affairs Publishing House), Moscow, 1951.

Regulations governing the cargo marking of the maritime ships, the Maritime Register of the USSR, Vodtransizdat (Water Transport Publishing House), Moscow - Leningrad, 1953.

PUZANKOV and RYABCHIKOV. The type of icebreakers, Vodnyy Transport (Waterways Shipping), Issues 2 - 3, 1933.

PESKOV, N. N. The ships assigned for navigation in the ice-bound areas. Symposium of articles in "For the Soviet Navigation", VNITOVT and LONITOVT, Issue II, Leningrad, 1935.

PESKOV, N. N. Construction of ships for navigation in the ice-bound areas. The Water Transport (Vodnyy Transport), No. 6, 1934.

PETRUSHEVSKIY, V. and A. (De-Shey). The Ship Operational Practice, Volume I. St. Petersburg, 1908.

PETRUSHEVSKIY, V. A course of Maritime Affairs for the apprenticeship, St. Petersburg, 1891.

POOR COPY

STAT

POLONSKIY, V. I. The car operating installation of the vessels in the conditions of Polar Sea navigation. Novosti Tekhniki (Technology News), Nos. 56 and 57, 1934.

POS'ET, K. N. Arming of the naval units. St. Petersburg, 1849.

ROMM. The maritime experience or the main principles and rules enhancing the art of construction, arming, steering and guiding of the ship. Parts I and II, St. Petersburg, 1793.

RIKHTER, B. The experience of the Polar investigator, Sovetskaya Arktika (Soviet Arctic), July, 1938.

RUNDO, A. M. The use of the icebreakers on the internal waterways, by the data of foreign practice. Transactions of NKPS (Peoples Commissariat of Communications), 1929.

SAMOYLOVICH, P. D. The contract of maritime shipping in the Soviet law. Morskoy Transport (Maritime Shipping), Moscow - Leningrad, 1952.

SAMOYLOV, V. A. Semen Dezhnev and his time. Glavsevmorput' (Main Office of the Northern Sea Route), 1945.

SARYCHEV, I. Atlas of drawings attached to the maritime practice. St. Petersburg, 1888.

SOKOLOV, A. P. The Russian Maritime Bibliography, 1701 - 1851. St. Petersburg, 1883.

STAROKADOMSKIY, L. M. Navigation on board the icebreakers "TAYMYR" and "VAYGACH" 1910 - 1915. Sovetskaya Arktika (Soviet Arctic), No. 8, 1940.

STUDITSKIY, F. D. History of the discovery of the sea route from Europe to the Siberian rivers and to the Bering Strait. Moscow, 1883.

STAT

POOR COPY

STAT

SUKHOMUKOV, A. YA. Types of icebreakers and the shape of their hull. Transactions of LOVNTOVT, Volumes II - III, 1938.

The Customs Tariff guide No. 3, the tariff of the river transportation of the USSR for shipment of the cargo of great and small speeds, of oil loads in the tanks, for towing of the rafts and ships. Publications of the Ministry of the River Fleet of the USSR. Moscow, 1952.

Technological Encyclopedia, Icebreakers, Volume II, Moscow, 1930.

TELEGIN, A. The contemporary condition of the electric propulsion of the ship and the perspectives of utilizing the gas turbo-electrical transmission on board the vessels engaging in Arctic navigation. Morskoy Flot (Merchant Marine), Issue No. 4, 1947.

FILIPPOV, A. M. The Russians in Lapland in the XVI Century. St. Petersburg, 1901.

TSIDUL'SKIY, V. A. The Explosives Expert (Sverdlovsk) - Moscow, 1942.

TSURIKOV, V. A. Problems of the solidity of the ice. The Northern Sea Route)(Sevmorput'), XVI, 1940.

SHANDRIKOV, N. The steamship of the type of "SEVMORPUT'", Novosti Tekhniki (Technology News), Nos. 56, 57, 20, SMP /SEVMORPUT/, 1934.

CHELUCHENKO, B. The practical methods of the freezing of the ship in the winter repair operations. Morskoy Flot (Merchant Marine) Nos. 11, 12, 1945.

SHENPROK, A. M. Notes on formation of the bottom ice. GGI Publishing House, Nos. 64, 1934. /TN: GGI - State Hydrological Institute/.

STAT

POOR COPY

STAT

SHTYL'KO, A. The Volga - Caspian Navigation in the remote past, moscow, 1896.

RYDER, N. The maritime icebreaker, the Maritime Symposium, No. 11, 1865.

KHAKHILOV, A. The icebreakers. Technology News (Novosti Tekhniki), Nos. 56 and 57, 1934.

YANVARSKIY, A. The new icebreakers "I. STALIN" and "L. KAGANOVICH", Sovetskaya Arktika (Soviet Arctic), No. 7, 1938.

YATSYKOV, A. A flagman of the Arctic Fleet - icebreaker "I. STALIN", Tekhniki Molodezhi (Technology of the Youth). Issue No. 5, 1939.

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47	13 top	Around the anchor.		"
100	2 from bottom	Hull and the helm.	The hull	"
168	24-25 from top	If the towing cable is delivered from icebreaker without an especial stop or prepared encircling mooring.	Or, if the towing cable is delivered from icebreaker without a special stop, prepare the belt mooring.	"
178	4 from bottom.	One cannot stop.	One cannot blow through	"
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THE BASIC FEATURES IN THE DISTRIBUTION OF THE ZOOPLANKTON IN THE NORTHWESTERN PACIFIC

/Page 113/

The northwestern part of the Pacific Ocean is a place where large masses of the pelagic plankton-consuming fish accumulate. It is also the feeding ground of the whales, the distribution of which is organically connected with the distribution and concentration of the food zooplankton in separate sectors. However the characteristics in the distribution and the fauna composition of the plankton of the northwestern part of the Pacific Ocean were, until recently, but slightly investigated.

Only in the last few years this area was intensly investigated by the Soviet and foreign expeditions. In 1949, 1953 and 1954 a complex oceanographic expedition of the Institute of Oceanography operated on board the expedition vessel "VITYAZ'"; in 1951, 1953 and 1954 the investigations were conducted by the expeditions of the Institute of Oceanography of the Academy of Science of the USSR specializing in the study of the cetacian species, and also by the American Trans-Pacific Expedition (of 1953), as well as by a number of Japanese ships. The results of processing of the collections of the Trans-Pacific Expedition have not as yet been published. In the Japanese work comprising the region of the KOMANDORSKIY Islands, the area east of the Sangarski Straits and the area of the Bonin Islands (Anraku -Angaku, 1954 a, b), only the fauna composition of copepoda is analyzed, and nothing is said about the quantitative distribution of the plankton.

The materials collected by the Soviet expeditions give us an idea not only of the fauna composition but also of the quantitative distribution of the plankton. The results of the processing of the collections made by the expeditions of the laboratories of the cetacian entities of

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of the Institute of Oceanology in 1951 and 1953 have been published in the congributions of K. A. Lubny-Gertsyk (1955) and of K. A. Brodsky (1955). In the present work the distribution of the zooplankton is studied as inhabiting the area of the Kurile Ridge up to 171° of eastern longitude and from the Komandorsky Islands to 27 @ 30° of northern latitude.

The characteristic of the zooplankton is based on the collections made on board the expedition ship "VITYAZ'" in August - October 1954. For the collection of the plankton the Dzhedi gauze nets No. 38 were used with the surface of the entrance hole S-0.1 m² and gauze No. 140, S - 0.5 m². With these nets stratified catches were effected at the horizon of 0 - 10, 10 - 25, 25 - 50, 50 - 100, 100 - 200, and 200 - 500 meters. The specimens had been weighed, they were inspected under binoculars and the large specimens of the type of Euphausiacea, Calanus tonsus, Calanus cristatus, Parathemisto japonica, etc., had been counted.

Distribution of the Plankton Complexes.

The general distribution of the plankton in the northwestern part of the ocean depends to a high degree upon the nature of the water mass and upon the seasonal phenomena in the area of observation.

The region of the Pacific Ocean which we had investigated can be divided into two zones. The first is the zone of the boreal (northern) waters, occupying the entire region from Komandorsky and Aleutian Islands to 40° of N latitude. The southern boundary of this area passes not along a straight line, but is staggering in accordance with the diffusion by the northern front of the warm waters of the Kuro-Sio current. For same characteristic are the considerable changes of the temperature conditions of the waters in the course of a year. Thus, investigations on board the "VITYAZ'" in the Kurile waters in May - July 1953 have shown that the temperature of the surface layer of the water fluctuated from 1

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to 5°C. In the same area in August - September 1954 the temperature was raised up to 9 - 15° C.

At the relatively powerful winter cooling of the waters encompassing, due to the convected mixing the water layers down to the depth of 200 meters, and the summer warming of only a relatively thin layer of the surface waters, on a considerable part of the basin of the boreal (northern) regions and especially in the area adjacent to the Kurile Islands and Kamchatka, throughout the year the cold intermediate layer is preserved with the temperatures below 1 - 1.5° C. The presence of the layer of the cold "winter" waters, affects fundamentally the vertical distribution of the plankton (Vinogradov, 1954, 1955).

In the formation of the water masses of this area great significance is assigned to the water masses coming in from the Okhotski and the Bering Seas. At the mutual interaction of the water masses of the ocean with the water masses of the Okhotski Sea and the Bering Sea in an area extending over the Kurilo - Kamchatka depression, an area of the mixed water is produced, where due to a powerful vertical circulation a phenomenon arises which is analogous to the "Polar Front".

In comparison with the Kurile waters the warm waters of Kuro-Sio are marked by slight seasonal fluctuations of the temperature. The cold intermediate layer is absent. The warm waters with temperatures over 10° C occupy the full mass down to the depth of 400 to 500 meters. The differences in the origin, thermic regimen and the nature of stratification of the water masses of the boreal (northern) regions and the waters of Kuro-Sio is revealed in the first place in the composition of the plankton.

The moderately cold waters of the northern sea areas with surface temperatures of 9 - 15° C (August - October) are populated by a fairly homogeneous plankton complex, customary for the waters of the Okhotski Sea and the Bering Sea. The most characteristic for this complex are such types as Calanus tonsus, Calanus cristatus, Eucalanus

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bungii, Sagitta elegans (and below 100 meters also Eukrohnia hamata), Parathemisto japonica and Euphausia pacifica.

All these types may form accumulations with a very high biomass up to 2 gram/m^3. In the area adjacent to the Kurile Islands and the Island of Hokkaido, they are joined by Metridia ochotensis, and in the area of the mainland shelf a considerable role may be played by the Pseudocalanus elongatus, and the cocoons of the bottom animals.

In addition to these mass types, for the plankton complex of the moderately cold waters characteristic is the presence of a series of the less numerous, but constantly present forms, such as for instance: copepoda - Metridia pacifica, Candacia columbiae, Pleuromamma scutulata, Paraeuchaeta japonica; amphipoda:- Euphocaris challengeri and Hyperia galba; the medusa Aglantha digitale and a number of other types.

Directly in the zone of the confluence of the cold waters of the moderate area with the warm waters of the Kuro-Sio, the shape of the zooplankton changes quickly and sharply. In the surface layers, at a temperature raised to 17° C, the species characteristic for the northern areas, vanished, by descending below 100 meters, and after that also 200 meters. Due to the disappearance from the surface zone of the mass aspects of the cold water plankton, the importance of Calanus pacificus and a number of small copepoda rises in proportion; a considerable quantity of the species absence in the northern areas, and in particular of Penilla avirostris and Pleuromamma specialis appear, and play a considerable role in the warm water plankton.

In the waters with temperatures above 18° C the planktons have no longer anything in common with the plankton of the colder waters, either by their appearance or in regard to relation and significance of individual taxonomic groups. The difference in appearance is sharply increased. Especially conspicuous is the appearance of the Pteropoda (Euclio, Peraclis, Cavolinia and others), Heteropoda (Pterotrachea, Carinaria, Atlanta), the hypereid

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Curvicornia (Lycaeidae, Brachyscelidae, Oxycephalidae, Rhabdosomidae and others) of Sergestidae (Lucifer), of the genus of Sapphirina, Copilia, Corycaeus among the copepods, of the Salpha (Salpa, Cyclosalpa, Doliolum), of the siphonophores, of the bedbug type of Halobates and others groups characteristic for the tropical plankton.

The plankton of these areas quantitatively is very poor, in spite of a great variety of appearance.

With the advance in the southern direction and with a rise of temperature from 20 to 26° C a series of new genera appears, but the general appearance of the plankton is almost unchanged.

The sharp change of the phenological structure of the plankton, attended by the reduction of its biomass, observed at the transition from the moderately cold waters of the northern part of the Pacific to the warm waters of Kuro Sio, makes it possible to consider the junction zone of these water masses as a boundary between the various zoogeographical regions. Also K. A. Brodskiy arrived at similar conclusions (1955).

Judging by our data in August - September this limit passes along the latitude of 40 - 42° and only near Japan under the effect of a cold current, proceeding along the Kurile Ridge, proceeds southward. Depending upon the change of the northern boundary of the waters of Kuro Sio also its position is changed.

The materials collected by M. M. Sleptsov in August of 1954 and the same materials being processed by us show that the individual branches of the Kuro Sio water masses are populated by a warm water plankton, and reach down to 43 - 44° of northern latitude.

In the whole investigated area, with the exception of the region closely adjacent to Japan and being affected by the current passing through the Sangarski Strait from the Sea of Japan, this limit coincides with the surface isotherm

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18° C (Figure 1). Just about on the same latitude (38 - 42° N) the zone of the sharp change of fauna was present also in 1941 - 1952 (Anraku, 1954).

Figure 1. Distribution of the basic plankton complexes.

1 - boreal (northern) region; 2 - transition zone; 3 - tropical regions; 4 - stations of the expedition vessel "VITYAZ" in August - October 1954; 5 - the stations of the laboratory expedition for the whale species in August - September 1954.

In addition to the fauna composition of the boreal waters differ widely from the waters of the Kuro Sio also by the general biomass of zooplankton. The boreal surface waters are richly populated with plankton throughout. The biomass of the zooplankton in the upper 100-meter layer fluctuates from 200 to 1,000 mg/m^3, while in the waters of Kuro Sio in the same layer it is usually 10 to 20 times less.

The comparison of the primary production of plankton ("phial methods" by the photosynthetic effect) showed that the daily production of the carbon in the warm waters of Kuro Sio is 10 to 20 times less than in the boreal area (Bogorov and Beklemishev, 1955). Thus in the waters of Kuro Sio the plankton is much poorer than in the boreal waters. This pauperization can be explained by the fact that in the surface stratus of the warm waters there is too little food plankton - the mass accumulations of calani and other large copepoda, euphausiidae and amphipoda are absent. For this reason the conditions of sustenance for plankton consuming fish en mass, there to include also the whales, are here adverse.

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Distribution of the Biomass of the Plankton.

By distribution of their plankton biomasses, the boreal (northern) waters in the investigated area can be subdivided into several zones. The first zone includes the waters which are in the immediate vicinity of the Kurile Islands, the others, - are the waters above the Kurile - Kamchatsky depression; the third zone occupies the southern portion of the area where the boreal waters extend. Separately those water masses should make an area for themselves which extend 20 - 30 miles of Hokkaydo.

The water masses in the m immediate vicinity of the Kurile Islands are somewhat pauperized. In May - June ~~1953 the biomass of plankton~~[1] ~~in the stratum of 0 - 100~~ meters was not over 500 mg/m^3 in the vicinity of the Kurile Islands; in August - September 1954 it fluctuated in this area from 250 to 500 mg/m^3. The width of this "belt" is relatively small - from a few to 50 miles from the coast (Figures 2 and 3).

Figure 2. Distribution of the biomass of seston in the layer of 0 - 100 meters in May - June 1953 (set up by L. A. Ponomarevoy).

1 - less than 500 mg/m^3; 2 - 500 - 1000 mg/m^3; 3 - over 1000 mg/m^3

Figure 3. Distribution of the biomass of the zooplankton in the layer of 0 - 100 meters in August - October 1954.

1 - over 500 mg/m^3; 2 - 250 - 500 mg/m^3; 3 - 100 - 250 mg/m^3; 4 - less than 100 mg/m^3; 5 - "Efflorescence" areas.

Footnote 1. The data on the biomass of the plankton in May - June are taken from the report of Miss L. A. Ponomarevoy who was in charge of plankton collection on board the expedition ship "VITYAZ".

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Behind the coastal waters with little biomass of the zooplanktons the zone of the high biomass is located. This zone stretches along the Kurile Islands in a tract of varying width, but usually not over 30 - 50 miles. In May - June 1953 the biomass of plankton in this zone in the stratum of 0 - 100 meters was consistently in excess of 1,000 mg/m³. In August - September 1954 it was slightly lower and fluctuated from 500 to 1000 mg/m³. Thus, even though the quantity of the zooplankton was reduced, the disposition of the zone of the highest biomass did not change. Roughly this is the same area which was the richest also at the end of July 1951. (Lubny-Gertsyk, 1955).

South of the Kurile Kamchatka depression the biomass of the zooplankton in the upper 100 meter stratum in May - June 1953 was reduced to 500 - 1000 mg/m³, and in August - September 1954 down to 250 - 500 mg/m³, that is about twice. Still further to the south approaching the limits of the boreal area, it dropped sharply to 100 - 250 mg/m³ in August - September.

In the area located east of Sangarski Strait, the quantity of plankton is relatively large: from 250 to 500 mg/m³. But by its composition it somewhat differs from the plankton of the Kurile - Kamchatka depression zone by the fact that in same alongside with the species of the boreal region there are many representatives of the warm water neretic plankton. The latter is at the foundation of the rich development of the life in the warm waters, located from 38° of northern latitude to the small Kurile Ridge.

The transition from the boreal region into the warm waters of Kuro Sio is marked by a sharp drop of the biomass of plankton. In the Kuro Sio waters it is throughout less than 100 (and usually 50) mg/m³.

Figure 3. Distribution of the biomass of the zooplankton in the layer of:

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0 - 100 meters in August - October 1954.

1 - above 500 mg/m^3; 2 - 250 - 500 mg/m^3; 3 - 100 - 250 mg/m^3; 4 - less than 100 mg/m^3; 5 - "efflorescence" regions.

With relatively small size nets (S - 0.1 and 0.5 m^2), which we used for the collection of plankton, we could not well enough catch the rapidly moving forms of microplankton (large size amphipods, euphausida); therefore we cannot submit reliable quantitative data in regard to their distribution. Let us point out only that in the boreal zone predominant are: euphausidae - Euphausia pacifica, forming, according to the report of M. M. Sleptsov (1955), ~~xxxxx~~ colossal conglomerations (at the very surface of the water). Further, we find there the Thisanoessa inermis, Thisanoessa longipes and in the coastal areas Thisanoessa raschii; from among the amphipods Parathemisto japonica and in the deeper layers Cyphocaris challengeri carry on. Near the Kurile Islands and at the southern tip of Kamchatka in the zones of the termination of the cold waters also the large size Parathemisto libellula are met with.

The distribution of the large size Copepoda, constituting the overwhelming mass of the plankton in the waters of the boreal zone, completes the picture of distribution of the general biomass of plankton, which we have discussed above. The largest quantity of the large size Copepoda are found in the tract of a wide girth running along the Kurile Island at a distance of 40 - 50 miles from the coast or slightly closer to same. Further on their quantity recedes, but on some sectors which are affected by the waters moving from the Bering Sea, it can rise again.

As an example let us consider the distribution of one of the leading species of the boreal plankton - Calanus cristatus. In the waters with a cold intermediate stratum which is so characteristic for the Okhotskas and Bering Seas, as well as for the waters of the Kurile - Kamchatka depression, in the largest quantity the Calanus cristatus

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carries on in the stratum of 25 - 50 meters, less frequently at a depth of 50 to 100 meters. In the cold intermediate stratum the small crustacea are sharply diminishing, and frequently they are altogether absent. From the depth of 200 meters and up, the quantity of Calanus cristatus is rising again.

__Figure 4.__ The quantity of Calanus cristatus in the layer of 0 - 200 meters in August - October, 1954.

1 - 0.0.25 specimens (?) per m^3; 2 - 0.25 ~~- 1.0 specimens/m^3~~ - 0.5 specimens/m^3; 3 - 0.5 - 1.0 specimens/m^3; 4 - more than one specimen per m^3.

In the south of the moderate regions where there is no cold intermediate layer and where the temperature of the water is evenly diminishing along with the depth, the vertical distribution of Calanus cristatus is of a different nature: this small crustacean is not met with in the warmed surface waters at the depths of 25 to 50 meters, but deeper at 50 and especially at 100 meters, there it lives in the whole volume of the water, while its biomass is not at its minimum in the stratum 100 to 200 meters deep.

The geographical distribution of Calanus cristatus in the layer of 0.-200 meters (Figure 4) displays a rigid adaptation to the waters of the boreal area, the limit of which coincides with the southern limits of its distribution in the surface layers. In the depths of over 200 - 500 meters it expands considerably more to the south and was discovered by us in the stratum of 500 - 1000 meters at 30°52' of the northern latitude.

The vertical distribution of the biomass of the plankton is not the same in various parts of the investigated areas. In the temperately cold waters of the boreal region in the area adjacent to the Kurile Islands, affected by the

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waters of the Okhotski and Bering Seas and characterized by the stratification of the waters with a cold intermediate stratum, the richest in plankton are relatively poorly warmed (up to 10 - 12° C) surface waters.

In the areas of 0 - 25 meters the biomass may sometimes reach 2 gr/m³ and is fluctuating on an average between 200 - 1000 mg/m³, increasing in spring and decreasing in fall. Almost equally rich is the stratum of 25 - 50 meters, in which sometimes the same high rate of biomass of the plankton is found. In the stratum of 50 - 100 meters the biomass decreases, but it was especially low in the stratum of 100 - 200 meters, below which it rises again. Thus the poorest in biomass is the stratum of the cold intermediate waters.

The standard horizons of the specimens taken, are slightly dimmed by the poverty of biomass in the cold intermediate layer and at the same time it diminishes the quantity below the maximum of the biomass, since on the horizons of 50 - 200 and 100 - 200 meters, besides the waters of the cold layer the waters rich in plankton are both above and below this stratum. More differentiated is the selection of specimens in the cold intermediate layer and in the layers adjacent to it, showing the impoverishment of the horizons corresponding to the cold intermediate stratum, and a sharp enrichment of the stratum between 180 - 300 meters, located underneath it (Figure 5).

<u>Figure 5</u>. The vertical distribution of the biomass of a zooplankton on one of the stations in the area of the Kurile - Kamchatka depression.

The more sharply is expressed the cold intermediate layer, that much greater is its poverty in plankton. The interdependence between the sharpness of the cold intermediate layer and the quantity of plankton in same can well be seen at the crossing from the island of Iturup east

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(Figure 6). In this part where the section passes in the waters of the Kurile area of the ocean with the cold layer, the horizons of 100 - 200 meters are somewhat impoverished in plankton. However the area located 300 to 600 miles away from the Kurile Islands the biomass of the plankton in the stratum of 100 - 200 meters is higher than in the area of the Kurile - Kamchatka depression.

Figure 6. Distribution of the biomass of zooplankton on the cross-sections in the northwestern part of the Pacific Ocean.

a - in the area with the cold intermediate layers; b - in the area without the cold intermediate layer.

1 - more than 500 mg/m^3; 2 - 500 - 200 mg/m^3; 3 - less than 200 mg/m^3.

The impoverishment of this stratum in comparison with the lower and higher located strata is very slight or altogether imperceptible and the biomass of the plankton is receding with the depth; in our opinion this is connected with the vanishing of the cold intermediate layer in these regions.

Of an entirely different characteristic is the vertical distribution of plankton in the warm waters of the Kuro - Sio, in which the temperature is slowly reduced with the depth and until at the stratum of 400 - 500 meters it drops below 8 - 10° C.

In the surface waters powerfully penetrated by sunshine, the biomass is negligible. Below 10 - 25 meters it is but slightly increasing and after reaching its maximum at depths of 50 to 100 meters, again gradually drops with the depth.

At nighttime the quantity of the animals in the surface

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layers is somewhat increased, due to the rise from the depth layers of the various bathypelagic crustaceous calmars and fish.

The small thermic seasonal changes of the waters of Kuro-Sio do not provide conditions advancing the vertical circulation and mixing of the waters. Therefore the surface layers are not enriched with biogenous elements.

The absence of the food materials is limited by the development of phyto- and consequently of the zooplankton. Such a quantitative poverty of the plankton is characteristic also for the other areas of the Pacific Ocean located between 20 - 40°, of the northern latitude, where the vertical circulation of the water is very weak. Only in the zone of the equatorial divergence the biomass of the plankton is again increased (Graham, 1941).

THE SEASONAL CHANGES IN PLANKTON

We can give the appraisal of the seasonal condition of the plankton only in the boreal waters.

In the spring months - (May - June) in the surface zone huge quantities of zooplankton accumulate for food search, the crowd consisting chiefly of Calanus tonsus, Calanus cristatus and Eucalanus bungii.

In summer the small crustaceans passing into the V-shaped copepodital stage and after putting on fat, begin to descend deeper. Judging by the available data about the plankton of the Bering Sea, this descent to lower depths is most intensive in fall, just before setting in of the winter homothermy. As a result of the planktons' descent in the depth areas of the water its quantity is considerably diminished in the surface layers. Besides this in these regions also the whales thrive, together with saira and other plankton consuming fish and cuttle fish. This also

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reduces the concentration of the plankton in the surface layers.

Thus in May - July 1953 Calanus cristatus was met with in a larger portion of the masses of water in the quantity of more than five specimens per cubic meter in the upper hundred-meter layer, in August it was only 1.6 specimens per cubic meter, and in September, as well as in October, almost all over the universal quantity of the large-size diminutive crustaceans was less than one specimen per cubic meter.

The change of the contents of plankton in the upper 100-meter stratum can be illustrated with the following table.

Change of the Biomass of Seston in the Stratum of 0 - 100 meters (in mg/m^3)

Date	Coastal Kurile waters	Waters above the Kurile-Kamchatka Depression	Waters of the southern portion of the boreal region
May-June 1953	500-1000	1000	500-1000
August-October 1954	250-500	500 - 1000	250-500

Thus in spring the biomass of the plankton is approximately twice larger than in summer.

Analogous data are available also for the Bering Sea (Vinogradov, 1955). In spring (May - June) the average biomass of zooplankton in the central part of the sea in the stratum of 0 - 100 meters came up to 747 mg/m^3, while by the end of the summer (in August - September) it came down to 326 mg/m^3.

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At the end of May - beginning of June in the waters with the surface temperature above 3° C copious "fluorescence" of the water was observed by various diatomes. In August - September the mass aggregations of the phytoplankton were small "spots" of accumulations of the phytoplankton were noticed at this time near the coast of Kamchatka.

A tremendous development of the phytoplankton (chiefly Thalissiothrix) was detected between 155 and 170° of eastern longitude in the zone of junction of the boreal waters with the waters of Kuro-Sio. This is probably an efflorescence conditioned by the uninterrupted mixing of the waters in the zone of junction of the various waters (Figure 3).

The obtained data bear testimony to the fact that the months of May and June are the vernal biological seasons in the plankton of the boreal waters of the northwestern part of the Pacific Ocean, and August - October the summer season.

Since one and the same biological season for plankton takes place at various latitudes, by turns of calendar in different months (Bogorov, 1938) the various parts of the ocean simultaneously experience a variety of biological seasons. Thus, the vernal enrichments of the surface water in zooplankton in the southern part of the Sea of Japan, which is affected by the warm Tsusima current, takes place in March (Keznocheryanova, 1954), in the northern half of the Sea of Japan it takes place in May (Brodski, 1941, Kusmorskaya, 1950), in the cold Kurile waters at the end of May - beginning of June (by the data of L. A. Ponomareva). Just about the same time (in May - June) it takes place in the central area of the Bering Sea and somewhat later (in June - July) on the northern Bering Sea shoals and in the Bay of Anadyr (according to the data supplied by M. E. Vinogradov). On the contrary, a sharp autumnal decrease of the plankton begins earlier in the northern areas, and thereafter spreads further to the south. Thus, for instance, the area of the Anadyr Bay of the Bering Sea in October is in its biological autumn, while in the area of the Commander Islands the plankton at that time is in its summer stage.

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Obviously the whales in their food searching migrations, keep in the areas of the greatest concentration of the planktons in the surface layers and leave these areas as the concentrations of food are reduced. The feeding connection of the whales with the plankton is effected directly or through the small mass fish and the cuttle fish.

By the data of M. M. Sleptsov, the whales appear in the northern part of the Sea of Japan and in the area of the r"uthern Kurile Islands and Sakhaline in April - May, that L., in the period of the spring biological season in planktons. In May - June the whales come close to Kamchatka and the Kommando Islands. At this time characteristic for the plankton of these areas is also the vernal biological season. In July the whales pass through the Bering Strait in the Chukotskoe Sea, appearing there in the period of the vernal biological season in plankton.

Since the summer biological season in the plankton of the Polar Seas is very short (Bogorov, 1938), so in September the whales begin their reverse migration through the Bering Strait. In September they appear in the area of the Kommando Islands, by the termination of the biological summer in plankton; while in the area of the Kurile Islands - they appear in October, also before the end of the biological plankton summer.

Such connections of the wealth of plankton with the distribution of whales are merely hypothetic, and require further investigation for a detailed elucidation of the properties of said mutual relations. The solution of this task will make it possible to work out a system of prognostigation for the migration of the whales, of the places and times of their accumulation (concentration).

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BIBLIOGRAPHY

BOGOROV, V. G. The biological seasons in the plankton of the seas on various latitudes. DAN USSR, Volume XIX, Fasc. 3, 1938.

BOGOROV, V. G. and BEKLEMISHEV, K. V. The primary production in the northwestern part of the Pacific Ocean. DAN USSR, 1955.

BOGOROV, V. G. and VINOGRADOV, M. E. Zooplankton in the northwestern part of the Pacific. DAN. USSR, Volume CII, Issue No. 4, 1955.

BRODSKI, K. A. Survey of the quantitative distribution and composition of the zooplankton of the northwestern part of the Sea of Japan. Zoological transactions of the Institute of DAN. USSR, Volume VII, Issue 2, 1941.

BRODSKI, K. A. Distribution of the plankton in the northwestern part of the Pacific. DAN. USSR, Volume 101, Issue No. 5, 1955.

VINOGRADOV, M. E. The diurnal vertical migrations of the zooplankton in the seas of the Far East. Transactions of the Institute of Oceanology, DAN. USSR, Volume VIII, 1954.

VINOGRADOV, M. E. The vertical distribution and migrations of the zooplankton of the Okhotskoe and Bering Seas and the northwestern part of the Pacific Ocean. Self reference, M. 1955.

KUSMORSKAYA, A. P. Composition and distribution of the plankton in the northwestern part of the Sea of Japan in the first part of the summer of 1941. Transactions of the All Russian Hydrobiological Society, Volume II, 1950.

LUBNY - GERTSYK, E. A. Some data bearing on the distribution of the plankton in the northwestern part of the Pacific Ocean. DAN. USSR, Volume CI (101), Issue No. 3, 1955.

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MESHCHERYAKOVA, I. M. The winter plankton of the central part of the Sea of Japan. Reports of the Pacific Institute of Fisheries and Oceanography (TINRO), Volume XXXIX, 1954.

[illegible]V, M. M. Biology of the cephalopod mollusks of the Far East Seas and the northwestern part of the Pacific. (This is an article appearing in the present publication - TN).

ANRAKU, M. Gymnoplea Copepods collected in the Aleutian waters in 1953. Bulletin of the Faculty of Fisheries, Hokkaido University, Volume 5, Issue No. 2, 1954a.

ANRAKU, M. Copepods collected on the whaling grounds of northern Japan and around the Bonin Islands. Bulletin of the Faculty of Fisheries, Hokkaido University, Volume 5, Issue No. 1, 1954b.

GRAHAM, H. W. Plankton production in relation to character of water in the open Pacific. Journal of the Marine Research, Volume IV, Issue No. 3, 1941.

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